PROCEEDINGS

OF THE

LITERARY AND PHILOSOPHICAL SOCIETY

OF

LIVERPOOL,

DURING THE

FORTY-NINTH SESSION, 1859-60.

No. XIV.

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1860.

The Authors alone are responsible for facts and opinions.

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ON THE SOCIETY'S ROLL AT THE CLOSE OF THE 49th SESSION.

Life Members are marked with an asterisk.

Oct. 11, 1833 Aikin, James, Esq., 2, *Drury-lane, and* 4, *Gambier-terrace.*
Nov. 17, 1851 Anderson, Robert Worrall.
Dec. 11, 1854 Andrew, John, 28, *Brunswick-street, and Sandown-park, Wavertree.*
*Nov. 28, 1853 Archer, Thomas Croxen, *Industrial Museum of Scotland, Edinburgh.*
Jan. 22, 1855 Atkin, George, 36, *Dale-street, and Rock-park, Rock Ferry.*

Nov. 18, 1852 Atkin, James, 190, *Grove-street.*

Feb. 22, 1855 Avison, Thomas, 18, *Cook-street, and Fulwood-park, Aigburth.*

May 1, 1854 Bahr, George W., 4, *Cable-street, and* 2, *South-hill Grove, Aigburth.*

Oct. 31, 1859 Batty, Thomas, M.R.C.S.E., *Greenfield House, Liscard-rd.*

Nov. 17, 1851 Bean, William, H.M.Customs, *Revenue-buildings, and* 56, *Berkeley-street.*

March 9, 1857 Bell, Christopher, *Moor-st, and* 60, *Bridge-st., Birkenhead.*

Feb. 6, 1854 Bennett, William, 65, *Sir Thomas's-buildings, and* 109, *Shaw-street.*

Oct. 31, 1859 Birch, James, 13, *Rumford-place, aud* 7, *Upper Baker-st.*

Feb. 4, 1856 Bird, W. Vallentine, M.D. Aberd., 2, *Beaufort-terrace, Seacombe.*

Oct. 18, 1858 Birschel, John William.

Oct. 31, 1859 Bloxam, Frederick William, *Liverpool and London Insurance Buildings, Exchange.*

Nov. 7, 1834 Boult, Francis, 26, *Chapel-street, and* 15, *Devonshire-place, Claughton.*

*Mar. 6, 1835 Boult, Swinton, 1, *Dale-street., and* 3, *Bedford-street South.*

Nov. 13, 1854 Bretherton, Edward, F.G.S., 21, *Harrington-street, and* 47, *Hamilton-square, Birkenhead.*

Oct. 21, 1844 Bright, Samuel, Esq, 1, *North John-street, and Sandheys, Mill-lane, West Derby.*

*Jan. 8, 1855 Brockholes, James Fitzherbert, 16, *Egerton-terrace, Cleveland-street, Birkenhead.*

*Nov. 12, 1855 Brooke, Richard, F.S.A., 16, *Canning-street.*

May 5, 1851 Brougham, James Rigg, Barrister-at-Law, Registrar Court of Bankruptcy, 20, *South John-street, and* 3, *St. Aidan's-terrace, Claughton.*

May 3, 1857 Burton, Rev. Charles Henry, M.A., 1, *Sandon-terrace.*

*May 1, 1848 Byerley, Isaac, F.L.S., F.R.C.S.E., Professor of Animal Physiology, Queen's College, *Victoria-road, Seacombe.*

Dec. 1, 1851 Clare, John Leigh, 11, *Exchange-buildings, and* 22, *Richmond-terrace, Breck-road.*

Oct. 31, 1859 Clark, Charles H., 17, *North John-street.*

Jan. 26, 1857 Clay, William, 97, *Sefton-street, and* 4, *Parkhill road.*

Nov. 16, 1857 Cooper, Joseph, *Oak House, Aigburth.*

May 31, 1858 Collingwood, Cuthbert, M.A.Oxon. M.B., L.R.C.P., F.L.S., Lect. on Botany, Liverpool Roy. Infirmary Sch. of Med., 15, *Oxford-street.*

Jan. 22, 1850 Cox, Henry, 15, *Exchange-alley N., and Poplar-rd., Oxton.*

Jan. 12, 1857 Cranbrook, Rev. James, Professor of English Literature, Queen's College, and Hon. Lect. on Literature, Liverpool Soc. of Fine Arts, *Liscard.*

Feb. 4, 1856 Cunningham, John, F.G.S., 5, *Cook-street, and Belmont, Grosvenor-road, Claughton.*

Oct. 21, 1834 Dale, Robert Morris, *Exchange-st. E., and Childwall Abbey.*

*April 6, 1840 Dickinson, Joseph, M.A., M.D.Dub. and Cantab., L.R.C.P., F.R.S., M.R.I.A., F.L.S., 92, *Bedford-street South.*

Dec. 12, 1859 Dobson, Thomas, B.A. St. John's Coll. Cantab., Head Master of the School-Frigate "Conway," *Bath Cottage, Rock Ferry.*

Nov. 27, 1848 Dove, Percy Matthew, F.S.S., 1, *North John-street, and* 49, *Hamilton-square, Birkenhead*

Jan. 23, 1848 Drysdale, John James, M.D. Edin., 44, *Rodney-street.*

Feb. 4, 1856 Duckworth, Henry, F.R.G.S., F.G.S., 5, *Cook-street, and* 2, *Gambier-terrace.*

Jan. 9, 1837 Duncan, William Henry, M.D. Edin., Medical Officer of Health, 2, *Cornwallis-street, and* 17, *Peel-terrace, Upper Canning-street.*

*Nov. 27, 1848 Edwards, John Baker, Ph.D. Gies., F.C.S., Lect. on Chemistry, Liverpool Roy. Infirmary Sch. of Med., *Royal Institution Laboratory, and* 46, *Nelson-street.*

Nov. 16, 1857 Elliot, James, F.R.S.S.A., Professor of Mathematics, Queen's College, Liverpool, 131, *Falkner-street.*

Dec. 15, 1856 England, Rev. James, M.A., 162, *Grove-street.*

Nov. 18, 1850 Evans, Henry Sugden, F.C.S., 52, *Hanover-street, and* 94, *Huskisson-street.*

April 30, 1860 Fabert, John Otto William, 1, *Parliament-st*, & 15, *Nile-st.*

*Dec. 14, 1846 Faram, John, 8, *Railway Cottages, Edge Hill, and Lime-street Railway-station.*

*Dec. 13, 1852 Ferguson, William, F.L.S., F.G.S., 62, *Gresham House, Old Broad-street, London, E.C.*

*April 3, 1837 Fletcher, Ed., 4, *India-buildings, and* 31, *High Park-street.*

Feb. 6, 1854 Fletcher, Fred. Dicker, M.R.C.S.E., Lect. on Anatomy and Physiology, Liverpool Roy. Infirmary Sch. of Med., Surgeon to the Workhouse, 15, *Upper Duke-st.*

*Mar. 19, 1855 Foard, James Thomas, 34, *Church-st.*

*Feb. 6, 1854 Gee, Robert, M.D.Heidelb., L.R.C.P.E., M.R.C.S.E., Lect. on Patholog. Anat. Liverpool Roy. Infirmary Sch. of Med., Physician to the Workhouse, 10, *Oxford-street.*

March 3, 1856 Grainger, John, B.A., 4, *Chapel-street, and Belfast.*

Nov. 14, 1853 Greenwood, Henry, 32, *Castle-st., and Roseville, Huyton.*

Nov. 30, 1857 Grimmer, William Henry, 15, *Cable-st., and* 64, *Grove-st.*

Jan. 22, 1855 Hakes, James, M.R.C.S.E., Surgeon Northern Hospital, 12, *Maryland-street.*

Nov. 33, 1857 Hall, Robert Henry, 18, *King-street, and Sandfield House, Whiston.*

Oct. 18, 1858 Hamilton, Robert Gordon, 12, *Tithebarn-street, and* 99, *Bedford-street South.*

*Jan. 21, 1856 Hardman, Lawrence, 14, *Dale-street, and Rock-park, Rock Ferry.*

Nov. 14, 1837 Hartley, John Bernard, *Coburg Dock, and Allerton.*

*Mar. 7, 1842 Heath, Edward, Esq., *Orange-court,* 37, *Castle-street, and St. Domingo Grove,* 114, *Breckfield-rd. N., Everton.*

*Dec. 12, 1855 Hess, Ralph, 15, *South John-street, and* 17, *Upper Duke-st.*

Dec. 28, 1846 Higgins, Rev. H. H., M.A. Cantab., F.C.P.S., *Rainhill.*

*Oct. 31, 1836 Higginson, Alfred, M.R.C.S.E., Hon. Lect. on Anatomy, Liverpool Soc. of Fine Arts, Surg. Southern Hospital, 44, *Upper Parliament-street.*

Jan. 12, 1857 Holden, Erasmus, *Widnes, Warrington.*

Nov. 13, 1854 Holland, Charles, 17, *Tower-buildings North, and* 38, *Rodney-street.*

Mar. 22, 1847 Horner, Henry P., 10, *Basnett-street, and* 5, *Devonshire-road, Prince's-park.*

Nov. 4, 1850 Howson, Rev. John Saul, M.A. Trin. Coll. Cantab., Principal of the Collegiate Institution, *Shaw-street, and Dingle bank, Dingle-lane.*

Dec. 27, 1841 Hume, Rev. Abrah., D.C.L. Dub., *ad. eund.* Cant., Oxon., LL.D Glasg., F.S.A., M.P.S., 21, *Clarence-st., Everton.*

*Nov. 13, 1854 Hunter, John, Memb. Hist. Soc. of Pennsylvania.
Jan. 26, 1857 Hutton, David, 3, *St. George's-crescent.*

*Apr. 29, 1850 Ihne, William, Ph.D.Bonn, 316, *Upper Parliament-street.*
Feb. 23, 1857 Imlach, Henry, M.D. Edin., 3, *Bedford-street North.*
*Oct. 21, 1844 Inman, Thomas, M.D. Lond., L.R.C.P., F.B.S.E., Lect. on Principles and Practice of Medicine, Liverpool School of Med., Phys. Royal Infirmary, 29, *Rodney-street.*
Jan. 23, 1854 Jones, John, 28, *Chapel-street, and* 70, *Rodney-street.*
*Apr. 4, 1852 Jones, Morris Charles, 8, *Harrington-st., and* 75, *Shaw-st.*
May 5, 1851 Jones, Roger Lyon, *Liverpool and London Chambers, Exchange, and* 6, *Sunnyside, Prince's-park.*

Feb. 19, 1855 King, Alfred, 14, *Newington, and* 9, *Netherfield-rd. South.*

Jan. 10, 1848 Lamport, William James, 23, *Water-street, and* 5, *Beech-terrace, Beech-street, Fairfield.*
*Jan. 14, 1839 Lassell, William, F.R SS.L. and E., F.R.A.S., 27, *Milton-street, and Broadstones, Sandfield-park, West Derby.*
Oct. 21, 1844 Lear, John, 1, *North John-street, and* 22, *Holland-terrace, Duke-street, Edge Hill.*
Feb. 23, 1857 Lewis, James, *Liverpool and London Chambers, Exchange, and* 1, *Parkfield-road, Prince's park.*
Feb. 22, 1858 Little, Robert, *Liverpool and London Chambers, Exchange, and Rainhill.*

Oct. 20, 1859 M'Andrew, James Johnston, 5, *North John-street, and Greenfield Cottage, Bromborough.*
Oct. 18, 1858 M'Andrew, John, 18, *King-street, and Waterloo.*
*Oct. 21, 1844 M'Andrew, Robert, F.R.S., F.L.S., *Allhallows-chambers, Lombard street, London.*
Dec. 11, 1854 M'Ilveen, Alexander, Professor of Modern History, Queen's College, *Liverpool Institute, and* 9, *Sandon terrace.*
March 9, 1857 MacFie, Robert Andrew, 30, *Moorfields, and Ashfield Hall, Neston.*
April 4, 1853 Marrat, Frederick Price, 22, *Arcade, and* 2, *Peverille-terrace, Edge-lane.*

Jan. 21, 1839 Martin, Studley, *Exchange-chambers, and* 109, *Bedford-st.*
Feb. 5, 1844 Mayer, Joseph, F S.A., F.R.As.S., F.E.S., 68, *Lord-street.*
May 2, 1853 Milner, Rev. James Walker, M.A., 1, *Devonshire-terrace,* 324, *Upper Parliament-street.*
Dec. 12, 1859 Mitchiner, James H., 4, *South John-st*, *and* 103, *Grove-st.*
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Jan 8, 1855 Morton, George Highfield, F.G.S., 9, *London-road.*
April 16, 1849 Moss, Rev. John James, B.A., *Upton, Cheshire.*
Oct 29, 1850 Mott, Albert Julius, 19, *South Castle-street, and Holt-hill.*
April 3, 1854 Mott, Charles Grey, 27, *Argyle-street, Birkenhead, and* 2, *Shelwood-road, Holt-hill.*

Jan. 26, 1857 Neoroji, Dadabhai, Professor of Hindostanee, London University, *Sweeting-street, and* 210, *Breck-road.*
Oct. 20, 1856 Nevins, John Birkbeck, M.D. Lond., M.R.C.S.E., Lect. on Materia Medica, Liverpool Roy. Infirmary School of Medicine, 25, *Oxford-street.*
Dec. 15, 1851 Newlands, James, F.R S.S.A., Borough Engineer, 2, *Cornwallis-street, and* 4, *Clare-terrace, Duke-st. North, Edge Hill.*
*Nov. 29, 1847 Nisbet, William, L.F.P.S.G., *Church-street, Egremont.*
*Oct. 15, 1855 North, Alfred, *Sidmouth.*

*Dec. 28, 1846 Picton, James Allanson, F.S.A., 11, *Dale-street, and Sandy-knowe, Wavertree.*
Feb. 6, 1854 Prange, F., *Royal Bank Buildings, Dale-street, and* 2, *Grove-park, Lodge-lane.*

Jan. 8, 1850. Ramsay, Rev. Arthur, M.A. Trin. Coll. Cantab., *Highfield, West Derby.*
Mar. 13, 1812 Rathbone, Richard, 20, *Water-street, and Woodcote, Aigburth-road.*
Mar. 13, 1812 Rathbone, William, Esq., 20, *Water-street, and Green-bank, Wavertree.*
*Jan. 7, 1856 Rawlins, Charles Edward, Jun., 23, *Cable-street, and* 1, *Windermere-terrace, Prince's-park.*
*Nov. 17, 1851 Redish, Joseph Carter, 18, *Chapel-street, and Wavertree.*
Feb. 6, 1854 Rees, Wm , Poor-Law Auditor, *Old Trafford, Manchester.*

Mar. 20, 1854 Rigge, Thomas, 64, *Rodney-street.*

Nov. 2, 1840 Robberds, Rev. John, B.A., 58, *High Park-street.*

Oct. 18, 1858 Roberts, John, 25, *South John-street, and Pilgrim-street, Birkenhead.*

April 18, 1854 Rowe, James, 2, *Chapel-walks, and* 51, *Shaw-street.*

May 26, 1856 Samuelson, Newton, F.C.S., 3, *Hackin's-hey, and* 43, *Hope-street.*

April 6, 1846 Scholfield, Henry Daniel, M.D. Oxon., M.R.C.S.E., 14, *Hamilton-square, Birkenhead.*

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Dec. 14, 1857 Steele, Robert Topham, 4, *Water-street, and* 8, *Bedford-street South.*

Oct. 18, 1858 Stuart, Richard, *Brooklyn Villa, Breeze-hill, Walton.*

*Feb. 19, 1855 Taylor, John Stopford, M.D. Aberd., F.R.G.S., 1, *Spring-field, St. Anne-street.*

Jan. 23, 1843 Taylor, Robert Hibbert, M.D. Edin., L.R.C.S.E., F.B.S.E., Lect. on Ophthalmic Medicine, Liverpool Royal Infirmary School of Medicine, 1, *Percy-street.*

Dec. 11, 1854 Thompson, Samuel H., Esq., *Thingwall Hall, Knotty Ash.*

Dec. 10, 1849 Thomson, David Purdie, M.D. Edin., L.R.C.S.E., 11, *Nelson-street, Great George-square.*

Nov. 17, 1856 Tinling, Charles, 60, *Castle-st., and* 17, *Clarence-st., Everton.*

Dec. 1, 1851 Towson, John Thomas, F.R.G.S., Scientific Examiner, Sailors' Home, 47, *Upper Parliament-street.*

*Feb. 19, 1844 Turnbull, James Muter, M.D. Edin., L.R.C.P., Phys. Liverpool Royal Infirmary, 86, *Rodney-street.*

Nov. 16, 1857 Tymbas, Gregory, *York Buildings,* 14, *Dale-street, and Edge-lane Hall.*

Oct. 21, 1844 Vose, James Richard White, M.D. Edin., L.R.C.P., Phys. Liverpool Royal Infirmary, 5, *Gambier-terrace.*

Oct. 21, 1844 Walmsley, Joshua, 50, *Lord-street.*

Oct. 18, 1858 Watkins, John W., M.D., *Newton-in-the-Willows, near Warrington.*

Oct. 15, 1855 Wilks, William George, 1, *Dale-st., and Mill-bank, Anfield.*

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LIMITED TO FIFTY.

Nov. 6, 1812 Peter Mark Roget, M.D. Edin., F.R.C.P., F.R.S., F.G.S., F.R.A.S., F.R.G.S., &c., *London.*

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Feb. 12, 1819 John Stanley, M.D. Edin., *Whitehaven.*

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Dec. 5, 1821 Rev. Brook Aspland, *Duckinfield, Cheshire.*

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Jan. 4, 1833 James Yates, M.A., F.R.S., F.L.S., F.G.S., &c., *Lauderdale House, Highgate, London.*

April 12, 1833 Thomas Stewart Traill, M.D. Edin., F.R.C.P.E., F.R.S.E., F.G.S., &c., *Rutland-square, and Edinburgh University.*

Jan. 2, 1835 John Ashton Yates, F.R.G.S., *Bryanston-square, London.*

Jan. 2, 1835 George Patten, A.R.A., 21, *Queen's-road West, Regent-park, London.*

May 1, 1835 William Ewart, M.P., *Cambridge-square, Hyde-park, London.*

Nov. 2, 1835 The Right Hon. Lord Brougham and Vaux, M.A., D.C.L., F.R.S., Chancellor of the University of Edinburgh.

Oct. 17, 1836 Chevalier de Kirchoff, *Antwerp.*

Feb. 20, 1837 The Right Hon. the Earl of Burlington, M.A., LL.D., F.R.S., M.R.I.A., F.G.S., F.R.G.S., F.C.P.S., F.Z.S., *Belgrave-square, London.*

Nov. 12, 1838 Professor Airy, M.A., D.C.L., F.R.S., Hon. F.R.S.E., Hon. M.R.I.A., F.R.A.S., F.C.P.S., &c., Astronomer Royal, *Royal Observatory, Greenwich.*

Feb. 24, 1840 James Naysmith, *Patricroft.*

Nov. 2, 1840 Richard Duncan Mackintosh, L.R.C.P., *Exeter, Devonshire.*

Nov. 15, 1841 Charles Bryce, M.D. Glasg., Fell. F.P.S.G., *Brighton.*

Oct. 21, 1844 J. Beete Jukes, M.A., F.R.S., M.R.I.A., F.G.S., Local Director of the Geological Survey of Ireland, *Dublin.*

Oct. 21, 1844 T. P. Hall, *Coggeshall, Essex.*

Oct. 21, 1844 Peter Rylands, *Warrington.*

Oct. 21, 1844 John Scouler, M.D., LL.D., F.L.S., *Dublin.*

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Oct. 21, 1844 Signor L. Ballardi, *Turin.*

Oct. 21, 1844 Signor Michellotti, *Turin.*

Oct. 21, 1844 Thomas Bell Salter, M.D. Edin., M.R.C.S. Eng. and Edin., F.L.S., F.B.S.E., *Ryde, Isle of Wight.*

Oct. 21, 1844 Professor Alger, *Boston, U.S.*

Oct. 21, 1844 Sir Charles Lemon, Bart., M.A. Cantab., F.R.S., F.G.S., *Cardew, Cornwall.*

Oct. 21, 1844 Il Cavaliere Carlo Passerini, *Pisa.*

1844 William Carpenter, M.D. Edin., M.R.C.S.E., F.R.S., F.G.S., *Registrar London University.*

1847 Sir William Rowan Hamilton, LL.D., Hon. F.R.S.E., M.R.I.A., F.R.A.S., F.C.P.S., Astronomer Royal of Ireland, *Dublin.*

Nov. 26, 1848 Rev. Thomas Corser, M.A., *Strand, Bury.*

Jan. 8, 1850 Rev. St. Vincent Beechy, M.A. Cantab., *Worsley, near Eccles.*

Jan. 27, 1851 James Smith, F.R.SS.L. and E., F.G.S., &c., *Jordan-hill, Glasgow.*

Feb. 24, 1851 Henry Clarke Pidgeon, *London.*

Feb. 24, 1851 Rev. Robert Bickersteth Mayor, M.A. Cantab., Fell. St. John's Coll. Cantab., F.C.P.S., *Rugby.*

Jan. 26, 1852 William Reynolds, M.D., *Coed-du, Denbighshire.*

Oct. 17, 1853 Rev. James Booth, LL.D., F.R.S., &c., *Wandsworth, Surrey.*

Feb. 23, 1857 Thomas Hutchinson, M.R.C.S.E., H.M.Con. *Fernando Po.*

TREASURER'S ACCOUNTS, 1858-59.

Dr. *The Literary and Philosophical Society, in Account with* Isaac Byerley, *Treasurer, to October 3rd, 1859.* Cr.

	£	s.	d.		£	s.	d.
To paid Greenwood—Printing "Proceedings"	69	2	0	By Balance from last account	223	19	10¼
" Tinling—Printing and Reporting	22	12	0	" Subscriptions—Annual (87)	91	7	0
" Secretary's Expenses of management:— Postage and delivery of Circulars, Letters, Parcels, and Proceedings; Stationery and Envelopes; Clerical and Incidental Expenses	18	0	6	Arrears	19	19	0
" Secretary—For Editorial services	10	10	0	" Entrance fees	3	13	6
" Mrs. Johnson—Tea, coffee, candles, attendance, &c.	8	7	4	" Interest on Dock bond	4	5	7
" Collector's Commission and attendance	6	10	0				
	£135	1	10				
To Balance carried down	207	16	1¼				
	£342	17	11¼		£342	17	11¼

Balance brought down—

	£	s.	d.
Dock bond	£150	0	0
In hands of Treasurer	57	16	1¼
Exclusive of Arrears	£207	16	1¼

October 3rd, 1859. *Errors Excepted,*

Audited and found correct,

Isaac Byerley, *Treasurer.*

Thomas Inman, }
T. C. Archer, } Auditors.

ERRATA.

Page 34, line 8—*for* Rumkorff *read* Ruhmkorff.
„ 66, „ 15—*for* sensless *read* senseless.
„ 70, „ 6—*for* seasicknes *read* seasickness.
„ „ „ 10—*for* neophite *read* neophyte.
„ 73, „ 18—*for* inocuous *read* innocuous.
„ 75, „ 27—*for* succomb *read* succumb.
„ 87, „ 4 from foot—*for* Mellon *read* Melon.
„ 88, „ 4—*for* Valerianilla *read* Valerianella.
„ 90, „ 5—*for* dicolyledonous *read* dicotolyedonous.
„ „ „ 3 from foot—*delete* weight.
„ 93, „ 19—*for* stork's bill *read* stork's-bill.
„ 128, „ 16—*for* yarrellii *read* Yarrellii.
„ 171, at foot—*for* 1860 *read* 1800.
„ 174, line 21—*for* on *read* ou.
„ „ „ 4 from foot—*for* their objects *read* these objects.

THE LIVERPOOL

LITERARY AND PHILOSOPHICAL SOCIETY.

ANNUAL MEETING—Forty-ninth Session.

Royal Institution, October 3rd, 1859.

THOMAS INMAN, Esq., M.D., President, in the Chair.

The Secretary commenced the business of the evening by reading the following Report, which, on the motion of Mr. Higginson, seconded by Mr. Samuelson, was unanimously adopted:—

At the opening of last Session the Society numbered 195 members, of whom 43 were corresponding and 152 ordinary members. It now enrols 190.

To the ordinary members of last year six have been added by election, two removed by death, and eight withdrawn by resignation.

The Society has to regret the demise of one of its oldest members, the late Sir John Salusbury, who continued to the last to take a deep interest in its proceedings, though from infirm health he was rarely an attendant at its meetings.

In alluding to the loss by death of Mr. James Wright Whitehead, of the firm of Whitehead and Meyer, merchants, Liverpool, the Society pays but a small tribute to his worth. From an early age he found great pleasure in the study of natural history, and more recently gave much of his time to

the acquisition of specimens of the mollusca. The collection of shells in his cabinet was select, carefully named, admirably arranged, and particularly rich in northern species. Mr. Whitehead was an observer as well as a collector of the mollusca, and the Society will have to associate the hearing of many instructive and original remarks upon the subject with his respected memory.

From the corresponding members of last year one, too, has been removed by death, Mr. Thomas Nuttall, F.L.S. respecting whom the Council cannot better speak than in the words of the Rev. Henry H. Higgins, in his letter to the Secretary:

"DEAR SIR,

"At your request I enclose a few notes relating to my respected friend, Professor Thomas Nuttall, who died at Nut-grove, St. Helens, September 10th, 1859, aged 73 years.

"An account of the early part of his life, and of his travels in the Arkansas territory, was published in one volume, octavo, at Philadelphia, in 1819. To this I have not had access; nor have I thought it desirable, on the present occasion, to apply to sources of information which are open to others. For a biographical notice of this truly good and distinguished man, Dr. Emerson, of Boston, U. S., Mr. W. Carpenter, of Philadelphia, and Sir William Hooker, possess abundant materials, of which no doubt the public will in due time have the advantage.

"For the last six years, however, I have myself had very frequent opportunities of seeing Mr. Nuttall, and it is with mingled pride and regret that I now look back to the time during which I enjoyed the advantage of his society, and the privilege of his friendship. The few following incidents are taken from his own account, given during the last year of his illness.

"Mr. Nuttall went with his uncle to America in the year

1807, and remained there till the breaking out of the American war. He then came to England, but returned to America as soon as peace was restored. He was for twelve years Professor of Natural History in the American University of Cambridge. Having an estate left to him on condition of residence, he again came to England in 1841, and since that time has resided in his own house at Nut-grove.

"Whilst he was in America Mr. Nuttall delivered several courses of lectures on botany, which were never published. The materials for a work entitled 'Townsend's Journey across the Rocky Mountains,' from the Commencement as far as the Passage of the Red River, were taken from Mr. Nuttall's notes, and published without acknowledgement. Amongst other works, Mr. Nuttall himself published 'Genera and Species of North American Plants,' (Philadelphia, 2 vols.,) 'Continuation of Michaux's Sylva Americana,' (3 vols. royal 8vo, plates,) and many papers in the Philosophical Transactions of the Academy of Natural Sciences, Philadelphia, and of the Philosophical Society of Philadelphia.

"Since his final return to England Mr. Nuttall has been engaged in botanical researches of various kinds, aided by the efforts of his nephew, Mr. Jonas Booth, who from the Himalayan mountains, and from various parts of India, transmitted to Nut-grove cases containing plants valuable, and in some instances new, to science. Mr. Nuttall's pre-eminent acquaintance with the rhododendrons is well known, and the species of that genus which is *facile princeps* bears his name.

"Mr. Nuttall was no doubt chiefly a botanist; indeed, he has often been called the father of American botany, but his attainments as a man of science were by no means limited to an acquaintance with the vegetable kingdom. The members of a natural history club in Liverpool, whose meetings he frequently attended, were often surprised to find the professor equally at home whether the subject under discussion was

botanical or zoological; indeed, his memory for the names of natural objects was alike envied and admired. I come now to speak of the declining years of Mr. Nuttall's life. Retiring in disposition, his intercourse, even with his friends, was not characterised by an abundant flow of conversational remarks, yet on certain occasions, chiefly when by some incident reminded of his early explorations in the wilds of America, he would kindle with animation, and speak fluently and even eloquently. I remember bringing to him a little wild flower, with the name of which I was at that time unacquainted. 'Ah!' said he, 'I have not seen that plant for more than thirty years; it is *Chrysosplenium oppositifolium;*' and he then related how he had found it in America, and went on to name a large number of other flowers found in similar situations, though, as he said, he had not seen any of them for more than a quarter of a century. Thus even up to the time of his last illness his memory was as fresh and vigorous as it had been in the prime of life.

"Nor was he less remarkable for a truly philosophical and conciliatory spirit. Being himself a member of the Church of England, he appreciated that which was good wherever he might find it. Circumstances very frequently brought into contact with him the ministers and members of a Primitive Methodist chapel; with their peculiarities Mr. Nuttall was far from sympathising, yet he recognised them as striving to do good amongst the very poor and illiterate population of the neighbourhood, and both treated them and spoke of them with uniform consideration and kindness.

"His charity, too, was self-denying. Possessing an ample income, he was frugal almost to excess, scarcely allowing himself the comforts and lesser luxuries required by his advanced years; whilst at the same time the stream of his liberality towards those whom he considered to be deserving of it was never stinted.

"Shortly before his end, which was attended with much resignation and serenity, he declared, in few but earnest words, his firm belief in the truths of revelation, and said that in them he found both peace and hope. He was buried in the churchyard of Christ Church, Eccleston, Prescot.

"So terminated the life of my much venerated friend. Honoured and esteemed by his neighbours, his name will long be familiar throughout the scientific circles of Europe, and indeed of the world.

"I remain, Dear Sir,

"Yours truly,

"HENRY H. HIGGINS.

"Rainhill, Sept. 28th, 1859."

The Treasurer reported last year the investment in a bond of a portion of the Society's surplus funds. He will report to you a continuance of prosperity.

The Society has met this year at an earlier period than usual, and with the exception of an interval at Christmas, it will continue its fortnightly meetings till the end of April. This alteration in the time of meeting was made by the Society last session.

Towards the close of the last session the council had under their consideration the giving of occasional soirées in the apartments of the Society, and at the last sessional meeting a communication was made to the Society recommending one or more of these meetings, and asking that the council might be authorized to make the arrangements. It will be your pleasure to grant this to the new council, which act will be implied by your adoption of this Report in so far as it bears upon this question.

In accordance with the laws of the Society, the council have recommended for election the following:—

James Thomas Foard, George Highfield Morton, F.G.S., the Rev. John Robberds, B.A., Frederick Price Marrat, and John Birkbeck Nevins, M.D.

(Signed) THOMAS INMAN, *President.*
DAVID P. THOMSON, *Hon. Sec.*

ROYAL INSTITUTION, Oct. 3rd, 1859.

Mr. BYERLEY, the Treasurer, then submitted the balance sheet, which had been duly audited, and read his statement of accounts, which was unanimously passed.

The Rev. Henry H. Higgins, M.A., was elected President for the next triennial period.

A cordial vote of thanks was accorded to Dr. Inman, the retiring President; and the Society then proceeded, by ballot, to elect a Council for the present year.

The members chosen were Dr. Inman, Professor Archer, Mr. Byerley, Dr. Thomson, Dr. Edwards, Mr. Redish, Mr. Higginson, Mr. Duckworth, C. Collingwood, M.B., the Rev. John Robberds, Dr. Nevins, Mr. Foard, Mr. Morton, and Mr. Marrat.

The following were elected Vice-Presidents: Dr. Inman, Professor Archer, and Dr. Edwards. Mr. Byerley was re-elected Treasurer, and Dr. Thomson, Honorary Secretary.

ORDINARY MEETING.

The Society having resolved itself into an ordinary meeting, Dr. COLLINGWOOD placed upon the table a species of cuttle-fish, *Eledone cirrhosus,* obtained alive from the Rock Ferry slip. These animals, which were very difficult to be kept alive for more than four and twenty hours, were not unfrequently taken in deep water outside the river by the fishermen, but the locality whence this specimen was obtained was very remarkable. He also exhibited some very

rare Nudibranchs, which had been taken by Mr. Moore at Hilbre Island, on Monday last. These were a white specimen of the giant of the tribe, *Tritonia Hombergii*, and one of *T. plebeia*, deep sea species, both of which, however, had been before captured by himself at Hilbre. But the most important were the two species of the genus *Antiopa*, the history of which was not a little remarkable. In 1844 M. Verany named a species of Nudibranch which inhabited southern Europe, *Janus Spinolæ*, but as the name *Janus* was already used to designate a genus of insects, Messrs. Alder and Hancock, in their elaborate work, renamed it *Antiopa*. A remarkable crest between the dorsal tentacles, added to the lamellated tentacles, and branched cells of the papillæ, appeared to warrant a separation of this animal from the genus *Proctonotus*, which it much resembled. They therefore called it *Antiopa splendida*, and perhaps it was, without exception, the most beautiful of that beautiful tribe. It inhabited the Mediterranean and south coasts of Europe and England, and was added to the Liverpool fauna by himself during the present summer. Until 1851 it was the only species of *Antiopa* known, but in that year a new species was discovered at Hilbre Island by Mr. Byerley, which was figured by Alder and Hancock, and called by them *Antiopa hyalina*. Mr. Byerley found another in 1854, and a third was then upon the table, taken by Mr. Moore at the same spot. It possessed the crest and tentacles of *A. cristata*, but in other respects came nearer to the *Proctonotus*. Here, then, in the same vessel were the two species of this remarkable genus—the one (*A. cristata*) having a singularly wide range, and being one of the few Nudibranchs we possess in common with the Mediterranean Sea, and the other (*A. hyalina*) having been hitherto nowhere seen except upon that little isolated rock at the mouth of the Dee, called Hilbre Island.

The following communication was then made:—

ON THE ELEPHANTS USED IN WAR, BY THE CARTHAGENIANS.

BY RICHARD BROOKE, Esq., F.S.A.

On the 10th of January last, I was induced to draw the attention of the members of this Society, to a point of considerable interest. From what country did the Carthagenians procure the elephants, which it is admitted by historians, they were in the habit of using in war?

We know from history that the Greeks under Pyrrhus, King of Epirus, used elephants in battle with the Romans, 279 years before our Saviour's birth, and that the Romans during the time of the Empire, commonly used these animals for purposes of state or magnificence; and in my opinion there cannot be any fair doubt that both the Greeks and Romans obtained them from Asia. The last time, as far as I am able to discover, that the Romans encountered elephants in battle was in the year of our Lord 627, when Gibbon * informs us, that in the Persian army opposed to the Emperor Heraclius, there were 200 elephants; and that after his victories over the Persians, he entered Constantinople in triumph, in a chariot drawn by four elephants.

With respect to the country from whence the Carthagenians obtained them, there may be some difficulty in coming to any certain conclusion. I have never yet met with any author who has ventured to assert, that the natives of Africa, either ancient or modern, had ever domesticated African elephants, or trained them to be useful in battle. Previously to our meeting of the 10th of January last, I was not aware of any writer who had thrown out a suggestion, similiar to the one

* Gibbon's Decline and Fall of the Roman Empire, vol. vi, p. 227 -230.

which I then made, that the Carthagenians obtained their elephants from Asia; but on recently referring to the Universal History, * in the account of the defeat of the Carthagenians, by the Romans, under Metellus, before Lilybœnum, in Sicily, I have found the following passage; "The fight was very obstinate for some time, and the Romans were even repulsed by the violence of the elephants. But at last the Dartmen wounded these boisterous animals, in such a manner, that they fell foul upon their own troops, and threw them into confusion. This being observed by the Roman general, he salied with a body of fresh forces out of the town, and attacking the enemy in flank, gave them a total defeat. The Carthagenians lost a vast number of men in this action, it being one of the greatest overthrows they ever received in Sicily, besides many elephants, which were either killed or taken, and amongst the rest ten with their Indian leaders."

Subjoined to this passage, I found the following note:—
"From the passage of Polybius here referred to, it is evident that the Carthagenians before the thirteenth year of the first punic war had an intercourse with India, as receiving elephants, and persons to manage and train them up from thence. This greatly strengthens what Pliny intimates, to wit, that the Carthagenians carried on a trade with the Indians, and imported from India many carbuncles of an inestimable value. This they must either have done by means of caravans, going through the interior parts of Africa to the Arabic gulf, if not through Egypt to Persia and India, or by their own vessels trading to those parts, or lastly by their cummunication with Tyre."

It will probable be in the recollection of the members who were present at the meeting of the Society, on the 10th Jan. last, that I then ventured to give it as my opinion, that the Carthagenians obtained their elephants from Asia through

* An Universal History, vol. 17, page 520, printed by Osborne, in 1748.

Tyre, or some other port of the Mediterranean, and from thence by sea to Carthage; which still appears to me, in the absence of any express authority to the contrary, to be the most reasonable supposition; and as tamed elephants were from a very early period commonly purchased from the natives of India, and conveyed into other countries, it is far more probable that they were sent from India by land to a Mediterranean port, and thence by sea to Carthage, than either by the Arabian gulf, or entirely by land from Asia, through Egypt to Carthage.*

In the conversation which ensued, the Chairman gave it as his opinion, that as Petra was the ancient highway for Indian traffic to Europe, and most probably to the north of Africa, and was eminently convenient for the passage by land across the isthmus, if elephants were sent from India to Carthage, they would be sent by that route, and not be shipped at all. Dr. Inman remarked that elephants were portrayed upon the sculptures of Nineveh. The trade between Mesopotamia and Palmyra was very extensive at one time. Elephants were supposed to have formed a portion of the tribute brought to the King of Assyria from India; and thus there was another way by which they might reach the shores of the Mediterranean, namely, through Assyria.

* See Foot Note, Society's Proceedings, 1858–59, No. xiii, p. 152. [Editor.]

SECOND ORDINARY MEETING,

ROYAL INSTITUTION, 17th October, 1859,

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The following resignations were received and accepted:—William Fisher, Ph.D., Messrs. C. Botterill, W. Mackinlay, W. Keith, and G. Casey.

Professor ARCHER submitted the skull of a gorilla, which had been received from Mr. Hutchinson, her Majesty's consul at Fernando Po. Also, a specimen of preserved cream from Switzerland, which on being opened was found to be in a perfectly fresh condition, though it had been in the bottle about four years. He explained that the mode in which it was prepared, by the Societé des Alpes, engaged in the manufacture, was simply by getting rid, through the agency of heat, of a species of animal ferment, the real cause of decomposition. He also called attention to some specimens of the "coal money" found at Kimeridge, in Dorsetshire, and read a communication on the subject from Mr. Mansel, in which the various conjectures as to their Roman, Belgic, or Phœnician origin, were examined. The material of which they were formed was a bituminous shale, and they bore every appearance of having been turned in a lathe.

Mr. C. S. GREGSON exhibited a small case of entomological specimens, including *Pterophorus Loewii*, Zel; *Tinea fuscescentella*, Greg.; *Tinea dubiella*, Greg.; *Homolota flavapes; Oxypoda formicilicola; Ptilium latum*, Greg.; *Monotama conicicollis;* and *Homolata anceps*. The last five species were all taken from the débris of an ant's nest (*Formica rufa*) in Perthshire, and several were new to our fauna.

The Rev. Mr. ROBBERDS drew attention to a brilliant display of red aurora borealis upon Wednesday last, more diffused, he thought, than it generally is.

Dr. THOMSON had seen, and there were recorded, very beautiful displays of deep red auroræ which passed through the usual phases of that phenomenon; the arch expanding as the aurora borealis continued, culminating in the magnetic meridian, and having brilliant corruscations.

Mr. HIGGINSON inquired if the aurora borealis had been seen by day, for certain forms of clouds conveyed the impression that if illuminated they would appear as auroral beams.

Dr. THOMSON replied that the aurora borealis had not been seen by daylight, though it had frequently been observed; sometimes in this country, but more frequently in the polar regions. So universal was the sympathy between the aurora borealis and the magnetic needle, that acute observers were able to predict a display of the phenomenon by the vibrations of the needle during the day. The clouds referred to were known to meterologists by the name of polar bands, and the connexion between the aurora borealis and the precipitation of moisture in the higher regions of the atmosphere in the forms alluded to was more than hypothetical. The intimate connexion of the phenomena had struck Humboldt, Wrangel, Kämtz, Bravais, Martins, and other meteorologists.*

The REV. HENRY H. HIGGINS, M.A., then proceeded to read his

INAUGURAL ADDRESS.

After a few preliminary sentences, chiefly occupied with an expression of thanks to the society for the honour they had done him in selecting him for the office of President, he said:

The name of our Society suggests a very wide range of subjects—literature and philosophy; learning, acquaintance

* See Dr. Thomson's "Introduction to Meteorology," p. 128.

with the writings of distinguished men in all ages and languages; science in all its branches, but more especially the explanation of the reasons of things.

An address of this kind is, however, expected to contain remarks, not so much upon the past state of literature and philosophy, as upon their progress, and upon the features which distinguish their advancement in the age in which we live.

It is probable that no two observers, together contemplating a phenomenon so vast as the joint progress of literature and science, would be struck with the same characteristic. To me there is one of almost absorbing interest, the practical bearing of which is so important and extensive, that I cannot for a moment hesitate in selecting it to be my subject on the present occasion. I refer to the gradual disappearance, before the light of increasing knowledge, of limits and distinctions which were formerly supposed to be exact and permanent. My illustrations will be taken first from the domain of science.

Between many extremes which were once considered to be wholly disconnected, it has long been known that no boundary line exists. Heat and cold, light and darkness, may be cited as examples. The Zero of our thermometers has perhaps never been regarded as anything beyond an imaginary line adopted for the sake of convenience. Yet for ages no doubt was entertained that the temperature of an object was the exact measure of the heat which it possessed. Nevertheless, temperature was subsequently found to give no indication except of that portion of the heat which is termed sensible. Still, heat, whether latent or otherwise, was considered to be a distinct entity. How shall we regard the progress of knowledge, which has made us acquainted with the convertibility of heat into light, force, electricity, &c., but as the taking away of limits the reality of which was never so much as doubted!

Light was thought to have its limit in darkness till it was known to be probable that darkness, even in the substance of the most solid bodies, is imperfect, and the existence of latent light was proved and beautifully illustrated by photography. The three primary colours obtained by the decomposition of white light were for a long time considered to be elementary, the intermediate hues of the spectrum being attributed to a kind of mechanical blending together in different proportions of the three primaries. This distinction, too, has passed away, and we have recently been made acquainted with an instrument which, by causing an extremely rapid succession of impressions of black and white to be made upon the eye, produces the appearance of colours varying with the velocity of the motion, thus practically exhibiting the intimate relations subsisting between the primary colours. Here, then, we have, in respect of heat and light, the removal of almost all the ancient boundaries. Let us now suppose in the earlier days of the scientific knowledge of light and heat it had been announced that there was no ultimate line of demarcation between the two, or between the primary colours—that temperature was no indication of the amount of heat present in a body—that light existed in the midst of solid substances, &c.—is it not more than probable the announcement would have been met with the objection, were such things possible utter confusion must be the result, and there would no longer be any certainty, any precision, in our knowledge of these things? Yet, as we now find, it is not so, these limits have been obliterated, but not a single fact has suffered loss either in optics or in thermal science.

Possibly no scientific system ever was calculated to give to its alumni more intense gratification than the theory of chymical equivalents, soon after it was promulgated. The numbers expressing the proportions of combining atoms were so simple, and the way in which the results were aptly

represented by a new nomenclature was so captivating, the discovery was hailed with enthusiasm, and pronounced to be complete. What would the discoverers say if they could see their theory in its present condition? The limits with which they surrounded the combining powers of the elements broken up, the compactness and simplicity of the system well nigh gone, the elements themselves shewing suspicious tendencies, and putting their character as elements into extreme peril. But has chymical science suffered? Far from it. The atomic theory itself has certainly not become less valuable, though bereft of the symmetry which was at first thought to be its highest excellence. Certain limitations have disappeared; the elementary substances are not seen with such sharply-defined edges as they formerly wore; but a broader, firmer grasp has been laid upon the subject; it is far more truly a possession of science now, with its difficulties increased, than when it was considered to be almost without intricacy, and wholly free from anomaly.

The results of abstract mathematical operations form a class by themselves, admitting nothing of an uncertain or indefinite character; hence the term exact, or pure, science, applied to this portion of our knowledge. It is not hard to see the reason of this. All such results, even the most complicated, partake of the nature of truisms; they may be read backwards or forwards, an exceptional result implying something exceptional in the process by which it has been obtained. Yet even amongst the simplest combinations of purely mathematical symbols may be found indications, that even that portion of truth which is capable of being represented by them cannot be circumscribed. Let us take for example $\sqrt{-1}$, the symbol of impossibility, or $\frac{1}{0}$, the symbol of infinity.

The use that is made of these symbols in applied mathematics is well known and deeply interesting. The appearance

of either of them in a formula, which has perhaps been obtained only after days or weeks of laborious calculations, may be compared to the discovery of a fossil by a geologist, after long and fruitless attempts to determine the formation prevalent in some unexplored region. An astronomer is computing the path of an approaching comet from elements which enable him to determine that its perihelion distance will be less than that of the earth: will the earth and the comet meet? He compares their respective orbits, and gets an expression answering to a supposed point of coincidence; the symbol $\sqrt{-1}$ appears in it—he knows the earth is safe, they cannot meet. The heavenly wanderer has passed away, is retiring into space, and the astronomer would anticipate its next return; he finds the expression for the distance at the point of reflex curvature in the orbit involves a term of the form $\frac{1}{0}$ (it implies that the distance of the turning point is infinite;) he knows the comet can never return, but is altogether lost to our system.

These little symbols, then, are not mere mathematical curiosities; they actually represent, more adequately than words can describe, impossibility and infinity, of all things perhaps the most incomprehensible, and yet involved in the very alphabet of mathematical analysis.

In every branch of applied mathematics inequalities are met with at almost every step; to approach indefinitely near to the required value is commonly all that can be done. I do not refer to the unavoidable inaccuracies of observations, but to the impossibility of obtaining perfectly exact results in calculations; indeed, nearly all the higher forms of calculations are attended with eliminations of terms which may, as it is said, be neglected; problems of many kinds are only to be worked by approximations; and even in the very simplest propositions the determinable and the indeterminable are mingled together. The diagonal of a square can never be

obtained in terms of the sides; the circumference of a circle can never be expressed by any number of which the radius is an unit, and if decimal places were added in diamond type reaching from the earth to the sun, they would only express very nearly the required value. There does not seem to be any necessity in the nature of things for it to be thus: yet, it is the ordinary course of knowledge at first to present an aspect of accuracy and completeness which afterwards it does not sustain. All things are at first supposed to be according to some known and definite plan, the symmetry of which often comes to be more cared for than the truth itself. Subsequently some fact appears which is unconformable, and damages a portion of the edifice built for the reception of the truth; gradually the walls fall away amid the expostulations of the builders, needless and inconsiderate, for their work has served a noble purpose, has facilitated examination, and in its very fall has demonstrated that truth, like its Divine Author, dwelleth not in temples made with hands.

Hitherto we have dealt only with things inanimate. In passing to the great field of animated nature, we shall find similar changes attending the advancement of knowledge, similar proofs that no scientific system can include or exactly represent the whole of the truth. It is said that Aristotle knew the difficulty of drawing a line which should separate the animal from the vegetable kingdom. But he certainly knew not the whole of the difficulty, for he had not, as we have, known one attempt after another, on physiological, chymical, and other grounds, to fix upon the exact limit, made only to add to the list of former failures. Practically, in the attainment of a knowledge of organised bodies the difficulty is unimportant: for the argument we are pursuing it is most important and significant. Here, at the very outset, we find the first two great divisions of living things, without a boundary line in science which can separate the one from the

other. It is difficult to expect greater accuracy, more complete definition possible, amongst the smaller groups.

The substitution of natural orders for the Linnæan classes in botany has become almost universal, yet we may lose much of the instruction to be derived therefrom if we regard the Linnæan method as a mere *memoria technica.* It is far more than this, and must be deemed, to a certain extent, a truly scientific plan. To give it the name of the artificial system, if by this we mean that it has no correspondence with nature, and to call its successor the natural method, if by this we mean that it has an entire correspondence with nature, is unphilosophical and unjust. The plans differ only in the degree of their correspondence with nature. That, however, which it concerns us most to notice is the change from the simple, sharply defined limits of the older system to the much more complicated and comprehensive marks of distinction established in the system which has taken its place. Yet the latter method has from time to time been found too straightened. New natural orders have been formed, old ones broken up into sub-orders, families into sub-families, genera into subgenera, species, and varieties; and still the diversity of form, structure, and habit to be found in the vegetable kingdom is far from being adequately represented.

Nor does inadequacy alone properly express the deficiencies of scientific systems. Laws of the most general character, such as have been for long periods of time supposed to be of universal application, at length are found in certain instances to fail. Let not these interruptions be accounted for by the childish notion of freaks in nature. Nature has no freaks. That which seems the wildest and most solitary exception is in perfect order with her real laws; in ourselves, and in our knowledge of these laws, lies the imperfection.

M. Agassiz claims for the divisions constituting the higher groups in zoology, such as classes, orders, families and genera,

the existence in nature which has been accorded by nearly all naturalists to species. It is very interesting after this to inquire what are his views as to the distinctions which characterise species. Rejecting the ordinary form of diagnosis, M. Agassiz insists that the description of a species shall include the whole of its life history from the embryo to maturity. A truly remarkable step in advance of all that has gone before, and as it seems to me wholly in the right direction. Let me call your attention to the correspondence between the change in the diagnosis of species proposed by M. Agassiz, and the advance from the Linnæan system to that of Jussieu in botany. Both are evidently portions of the very same course; in both the older, shorter, and more simple definitions are rejected for others more complicated and far more difficult. We are now taught that the marks by which species have hitherto been distinguished are insufficient, and that a widely extended series of observations is necessary before we can be prepared to describe a species as it exists in nature.

"If," says the Professor, "we would not exclude from the characteristics of species any feature which is essential to it, nor force into it any one which is not so, we must first acknowlege that it is one of the characters of species to belong to a given period in the history of our globe, and to hold definite relations to the physical conditions then prevailing, and to animals and plants then existing. These relations are manifold, and are exhibited—1st. In the geographical range natural to any species, as well as in its capability of being acclimatised in countries where it is not primitively found. 2nd. In the connexion in which they stand to the elements around them, when they inhabit either the water or the land, deep seas, brooks, rivers and lakes, shoals, flat, sandy, muddy or rocky coasts, limestone banks, coral reefs, swamps, meadows, fields, dry lands, salt deserts, sandy deserts, moist land, forests, shady groves, sunny hills, low regions, plains, prairies, high table

lands, mountain peaks, or the frozen barrens of the Arctics, &c. 3rd. In their dependence upon this or that kind of food for their sustenance. 4th. In the duration of their life. 5th. In the mode of their association with one another, whether living in flocks, small companies, or isolated. 6th. In the period of their reproduction. 7th. In the changes they undergo during their growth, and the periodicity of these changes in their metamorphosis. 8th. In their association with other beings, which is more or less close, as it may only lead to a constant association in some, whilst in others it amounts to parasitism. 9th. Specific characteristics are further exhibited in the size to which animals attain, in the proportion of their parts to one another, in their ornamentation, &c., and all the variations to which they are liable."

I make no apology for the length of this quotation, because, though the style in some parts may seem needlessly diffuse, it is a most striking illustration of the course we have been considering. Comprehensive as may appear the views of M. Agassiz respecting specific distinctions, they seem to afford us a philosophical conception rather than an exact definition. The last clause contains within itself a perplexing difficulty,—"all the variations to which they are liable." What is to determine the extent of these variations?

If, as some naturalists assert, an additional spot upon the wing of a butterfly is sufficient to warrant its separation from its *congeners*, here, at all events, we have something apparently definite; but only so apparently, for the spot may be found under every degree of development, and diminishing till it is only just perceptible, or doubtful whether it exists at all.

The definition of a species proposed by Dr. Carpenter at a recent meeting of the British Association is scarcely more successful. This distinguished physiologist considers a species to be "all the individuals that have, or that from their resem-

blance may be supposed to be, descended from a single pair." The practical inutility of this definition is obvious; its theoretical inaccuracy is proved by M. Agassiz, who shows that it involves assumptions made without sufficient foundation.

In behalf of his own definition, M. Agassiz might urge that the extent of variation to which a species is liable may be determined by the comparison of a large series of specimens, taking also into account all the characteristics he has so well enumerated. Now, if this had to be done for a few species only in the midst of others already well defined, the difficulty would be less. But in announcing the absolute character of specific distinctions, the systematist has to begin *de novo* with a world in which such distinctions have not as yet been founded. We may, however, suppose that generic distinctions have been established, confining his investigations to groups of individuals at present supposed to constitute from one to a thousand species. He may soon be able to fix upon certain well-marked, specific types; the real difficulty will begin where varieties spreading from two, three, or more of these specific types meet, occupying ground, it may be, where the normal characters of each are far less strongly developed, and the characters tending directly to assimilation with other specific types become conspicuous, not abruptly, but by imperceptible degrees. Further, it will be necessary to compare the supposed central and all the surrounding forms in their relations with characteristics derived from each of the nine heads proposed by M. Agassiz. Such are the terms involved in the equation for the figure, which is to include and include only, a species.

How far this differs from an admission, that no exact limit can be drawn at all, it is hard to say. Naturalists have always attached the highest importance to the validity of their specific distinctions. It cannot, then, be out of place to ask, what is really at stake on the issue of the question—whether specific distinctions can be exactly and adequately represented?

The question is by no means equivalent to the inquiry, whether specific limits exist in nature. It may be said by some, that if such limits do exist at all in nature, they exist by virtue of some fact which may be represented. But this by no means follows. Many things exist in nature which are perfectly distinct, and yet no boundary line can be drawn which shall with precision separate them. Mountains standing on a plain, the waves of the sea, the fingers of our hands, are all of this class. And if between objects which we know are not identical, but in which the aggregate of characters is comparatively small, we cannot draw the limit, much more may it be thus when we are concerned with a completely organised being, of which the author of the essay on classification asserts, "however simple in its structure it presents to our appreciation far more complicated phenomena, within our reach, than all the celestial bodies put together."

The degree of difference which may obtain between species, the boundaries of which we are not able to define, belongs to a far more comprehensive inquiry,—how and why are things distinct at all? The answer to which must be sought, at least in part, from a higher source than even nature itself. For nature is not another term for the Creator, but is only that expression of his will which he has placed before us in things of which we are conscious. Of the manner of his first great fiat we are not conscious. All we know of it is from testimony, written, or derived from indications presented by the works themselves. Both kinds of testimony unite in showing that there have been distinct creative acts,—that heat, and light, and the material elements, and all things living, were brought into existence endued with distinctive characters patent to observation, endued also with intimate relations amongst themselves, which it should be throughout all time the high privilege of man's intellect to discover and revere. Man's peculiar privilege it is, for even animals observe, distinguish, and discriminate with

a keen sagacity unrivalled by man; but what know they of relation and harmony?

This may lead to the remark, that the question whether specific distinctions can be exactly and definitely represented does not, except in an indirect manner, affect the highest ends of science. It does, no doubt, affect the completeness of the externals of science, and the nearer the approach of scientific systems to perfection, the better may they minister to our perception of the beautiful order and proportion and arrangement which may by their aid be recognised throughout the domain of nature. But, after all, the externals of science are only the helps to knowledge; and it is one of the most beneficent provisions made by the great source of all truth, that much imperfection in the means of scientific knowledge, nay, that some amount of positive error mingled with the knowledge itself, does not render impossible the attainment of the very highest end to which such knowledge can be subservient. Communion with nature—a soul filled with a sense of the beauty and the glory of the works of God,—gentlemen, I scruple not to term this a provision which could only have been made by one of infinite beneficence.

Few will venture to say that Linnæus, and our own Ray, and Lister, and Ellis, were less filled with the spirit of philosophy, had less real communion with nature than any in our own day. Yet, what were the externals of science then to what they are now? How much positive error was in their day undetected? And we, too, with all our manifold advantages in science, may occupy the same position in the retrospect of future generations that these great men hold with reference to ourselves, if, indeed, we are worthy to be compared with the least of them.

The completeness, then, of scientific systems affects only in part the highest ends of science. But there is slight need for apprehension that these externals of science will receive too little attention; such has never been the common fault. The

melancholy fruits of an opposite course are manifest, and form what may be justly termed the opprobrium of science in many of its eminent professors. What arrogance, what impatience of contradiction, what unwillingness to allow the claims of others, what assumptions of infallibility, are found in the writings of such men as Buffon and Lamarck? We need not perpetuate the vulgar error of indiscriminate condemnation: they were great men—they, too, had communion with nature,—but could this have been the origin of their asperity? Impossible? It sprung from an overweening sense of the importance of their own labours, in extending and rendering more exact, and perfecting as they thought the systems of classification to which they applied themselves; yet there is much in their systems which has already passed away.

It may be that we, too, often assume a wrong position before the works of God, claiming for the means of knowledge an honour due only to the objects of knowledge—a character of essentiality which experience fails to verify—an exactness which, inasmuch as it agrees not with nature, is truly a defect whilst deemed a merit. We would exhaust, instead of rejoicing that we have to do with the inexhaustible. In vain we see the fate of methods of former days. In vain we are met at the very threshold with signs that we are entering where we may learn and investigate and admire, but not exclusively possess. In vain is all this, if we know not to distinguish between the externals and the spirit of philosophy, and to forget all intolerance in the sacred presence of truth.

The illustrations afforded by the advancement of literature may now be briefly mentioned. To some extent, what philosophy and science are to nature, criticism and logic are to literature. I would, however, be understood to refer chiefly, not to the criticism current in journals and serials, but to that which is occupied with the older writers, and especially those of classical authority. It would not be difficult to select many

particulars in which the criticism of the present differs from that of any preceding age. One, however, may suffice. I refer to the greater importance now attached to the right apprehension of the circumstances under which authors whose works are treated lived and wrote; and this may be considered in every respect a remarkable feature. For we might naturally anticipate, in other respects, that criticism would improve with the accumulation of learning, and increased opportunities for literary fellowship; but as by the lapse of time it becomes more and more difficult thoroughly to understand the position of writers of antiquity, their habits of thought and motives, we might look for less weight to be given to these things as involved in growing uncertainty. But the reverse of this is really the case. Critics of other centuries seem to have cared comparatively little to put themselves in the place of the authors whose works they reviewed, but far more to show their erudition in contending for their own readings of obscure passages, such readings being insufficiently founded on an appreciation of the circumstances probably affecting the author's intention.

It is evident a judgment thus formed must be liable to many errors, and at all events do imperfect justice to the subject under review. The critic, satisfied with the citation of parallel passages, soon conceived he had exhausted all that could be said upon the matter, and was in danger of dogmatising through the narrow limits within which the question appeared to lie.

On the other hand, thoroughly to investigate whatever may be known of an author's life and disposition—to examine also every source of information respecting the class of persons for whom his works were designed—and to let all these considerations have their due weight—cannot but render the functions of criticism more onerous, but its results proportionably more valuable, because more truthful. If this be the character of

modern criticism, much good must come of it; yet some will complain, disputants will be deprived of many quotations proved to be in common use after quite another than the author's meaning, and fields of logomachia will lose much of their interest. Broader, deeper, perhaps less exact, will be the limits of criticism; but the noble thoughts of other days will be better understood, and the intentions of those who wrote them will receive more adequate fulfilment.

A remarkable hypothesis respecting logic has received much attention since the commencement of the present century. I refer to the alleged consequences of the imperfection of words as symbols. It is said there are many things which we know exist, but which cannot adequately be expressed by words, and that hence may arise errors in conclusions logically deduced. For, it is argued, operations with mathematical symbols yield accurate results, because the symbols themselves accurately represent the things for which they stand; but though the use of a word as an imperfect symbol in a simple proposition, such as the statement of a fact, may involve no error beyond imperfection, yet where words are used, as in syllogisms, in a process resembling a mathematical operation, the results may be entirely vitiated through their inadequacy, even as the use of impossible quantities in algebraical calculations may lead to doubtful results. It is, however, important to bear in mind that words are ordinarily very exact and sufficient symbols, so that comparatively few logical conclusions are affected by the argument above stated, which does, nevertheless, prove the necessity of a thoughtful use of words, of an examination how far they may or may not be accurate and sufficient representatives of facts and ideas, and forbids in all matters beyond our comprehension attempts to establish a mere verbal deduction as having infallible authority.

It has been my object in the foregoing series of illustrations to show that it is very much the character of truth to assume

a positive rather than a circumscribed form, not therefore becoming doubtful or uncertain, but manifesting itself to be inexhaustible, and ever inviting and leading the understanding onwards. In the earlier days of philosophy man would have been utterly discouraged had he been told even so much as is known to us of the complexity of truth. He employed the simplest kinds of distinctions as helps to knowledge, and some portions of truth disdained not to be reached by their means. Far more comprehensive are the appliances now used both in literature and in science, and further portions of truth are yielded to man, yet always so as may minister to his happiness, but not to his self-complacency; for his knowledge increases not so fast as his perception of the immensity of the unknown. And not fortuitously is it thus, but by a wondrous provision, more excellent than any instance of harmony in nature, being nothing less than the suitability of all that is in nature to the position and employment designed by the Creator for the mind of man.

But I must conclude. However hopefully we may speak and think of the progress of literature and philosophy; however we may admire their increasingly truthful aspect; it must, I think, be evident there are things more needful for us to recognise, than any we may gather in the fields of learning or of science. The amenities of language, the harmonies of nature, are but faint shadows of that wondrous relationship in which man is placed towards his Maker and his fellow man. Can religion, as it is, be accounted for by dialectics? Or shall we, on the principles of intellectual sympathy, and common interest, and natural affection, reason out the probable results, or classify the facts presented, as we contemplate the features of the intercourse subsisting between the members of our race? It cannot be! Systems so founded would be but in mockery of fact. A disturbing element has entered, working alienation, ignorance, crime, and sorrow. The spirit of

man mourns the interruption, and yearns for the renewal of a communion higher than any that can be obtained with nature. To know the remedy of this disturbing evil is the best of all knowledge. If sought, it may be found in HIM WHO SPAKE AS NEVER MAN SPAKE.

It is most gratifying to myself to feel assured that thoughts such as these will not by you be considered as out of place. Differing as we may, or rather as we must—for no two individuals perceive and think and feel alike—we are, I am persuaded, agreed in a conclusion which I may express in the words of Cowper:

"If all we find possessing earth, sea, air,
Reflect his attributes who placed them there,
Fulfil the purpose, and appear design'd,
Proofs of the wisdom of the all-seeing mind,
'Tis plain the creature, whom he chose to invest
With kingship and dominion o'er the rest,
Received his nobler nature, and was made
Fit for the power in which he stands arrayed,
That first or last, hereafter, if not here,
He, too, might make his Author's wisdom clear."

THIRD ORDINARY MEETING.

ROYAL INSTITUTION, 31st October, 1859.

SOIRÉE,

The Rev. H. H. HIGGINS, M.A., Presiding.

At this Meeting, to which ladies were invited, the entire buildings of the Royal Institution were thrown open, including the various Museums of Natural History, Geology, Ethnology, and Applied Science, together with the Gallery of Ancient Art.

After returning from an inspection of the interesting objects laid out in the various apartments, microscopes* and photographs;† the very rich collection of pictures in the gallery, and the bronzes contributed by Messrs. ELKINGTON and Co.,‡ the Rev. H. H. HIGGINS called on Members to make their annual contributions to our local Flora and Fauna, remarking himself that—It might be considered a point of some interest to determine at what period of the year occurred the height of the floral season in any given district; in other words, when might be found the greatest number of plants in flower. A series of observations continued for several years must be made before this point could be considered as satisfactorily settled, and he was not aware that in our own district much attention had been given to the subject. A tabular record of the culminating season of each of the natural orders would be a valuable contribution to our local flora. As a commencement, a few very imperfect notes were made by himself during the past season, and he would give them in the hope that more and better materials might be thereafter supplied. The notes were as follows:

July 1.—A walk of two hours, from Rainhill to Prescot Carrs and Huyton Quarry, afforded seventy-one species.

July 5.—A walk of three hours, at Rainhill, eighty-four species.

* Lent by several Members of this, and the Microscopic Societies.

† Exhibited by Mr. Foard, Church-street, and Messrs. Scott and Ferranti, Sandon-terrace.

‡ The following is a list of the bronzes contributed by Messrs. Elkington, which were much admired; Bust of Aristotle, real bronze; bust of Camilla, real bronze; bust of Diomedes, real bronze; bust of Antinous, real bronze; the first and second Peri, after Westmacott; two groups, "Happy Moments;" two bronze candelabra, with figures of Indians; two cups, "Centaur and Cupid;" one bronze figure, "Hercules Farnese;" one bronze figure, "Clapping Fawn;" one bronze figure, "Apollo;" one large bronze figure, "Venus de Medici;" one bronze group, "The Suppliant Mother;" one bronze group, "Youth Playing a Lute;" one bronze tankard, "The Bedford Jug;" a bronze jug, after Cellini; large gilt and oxide of silver shield, "The Battle of the Amazons;" large gilt and oxide of silver shield, "Siege of Troy."

July 26.—An excursion of eight and a half hours with Mr. Marrat, from Hoylake to Heswell, and thence to Rock Ferry, one hundred and eighty-four species. Caryophyllaceæ, 12; Leguminosæ, 14; Rosaceæ, 11; Umbelliferæ, 12; Compositæ, 30; Scrophulariaceæ, 11; Labiatæ, 10; thirty other orders—together, 84.

August 4.—A walk of four hours with Mr. Marrat, at Crosby, one hundred and nine species, of which seventeen were not found in the preceding excursion.

August 9.—Two hours at Rainhill, seventy-five species.

These lists include only flowering exogens in which, at the time of gathering, the anthers were distinctly visible. The species were limited to those recognised as such in Mr. Bentham's "Handbook to the British Flora."

Hippophæ rhamnoides, L.—Sea buckthorn; near Eastham, where it appeared to have been planted. Subsequently near Calder, on the Dee, apparently wild.

Scirpus palustris, L.—Variety with the outer bract broader, so as almost to enclose the base of the spike. (*S. uniglumis*, Bab.) Aintree, 1826; Hale-bank, 1859. H. S. Fisher. Sent to Mr. Babbington, and by him identified.

Trigonella ornithopodioides, De C.—Bidston-hill, June, 1859; plentiful. H. S. Fisher and F. P. Marrat. Not hitherto recorded as found nearer than the banks of the Dee.

Rosa tomentosa, Sm.—Hedges, Mollington, Cheshire. H. S. Fisher and T. Langford.

Veronica buxbaumii, Ten.—Lane at Green-bank, May, 1859. F. P. Marrat and H. S. Fisher.

Limosella aquatica, L.—Mud banks in a large pit, some distance south of Bromborough. H. S. Fisher.

Carduus nutans, L.—Field near the Botanic Garden, 1859. Mr. Burschel, Curat. Bot. Gard.

GERANIUM LUCIDUM, L.—Quarry, Green-bank. H. S. Fisher and F. P. Marrat.

To the FLORA, the following additions were made by Mr. F. P. Marrat:—

WEISSIA VERTICILLATA.—Abundant on the rocks by the Dingle. F. P. M.

TRICHOSTOMUM MUTABILE.—On the rocks on the river bank, between Eastham and Bromborough Pool and at the Dingle. F. P. M.

TRICHOSTOMUM RIGIDULUM.—A very singular form of this plant resembling Trichostomum strictum, (Bruch and Schimper,) having a thick excurrent nerve, occurs on a wall in Bromborough village.

GYMNOSTOMUM TENUE.—New Brighton. F. P. M., H. Fisher.

DICRANUM CRISPUM.—In a quarry at Childwall. T. Palgrave, Esq.

DICRANUM PALUSTRE.—Very abundant on a small heath near Bromborough Station. F. P. M., H. Fisher.

DICRANUM RUFESCENS.—Upright capsules of D. varium have been mistaken for this species. On a ditch side, Rainhill. Rare. F. P. M.

DISTICHIUM CAPILLACEUM.—The plant found on Rainford Moss, is Campylopus torfaceus.—I have examined plants from Mr. Skellon.

SCHISTIDIUM APOCARPUM.—A very small form of this moss is found on dry walls at West Kirby, Willaston and Sutton.

SCHISTIDIUM MARITIMUM.—Very plentiful with Tremostomum mutabile as above. F. P. M.

HEDWIGIA CILIATA.—On a wall at Willaston. F. P. Marrat and H. Fisher.

AULACOMNION ANDROGYNUM.—Prenton, F. P. Marrat. Wavertree, H. Fisher.

BRYUM MARRATII.—Near Ainsdale; the old locality destroyed.

HYPNUM SALEBROSUM.—Occured very plentifully last season from Crosby to Southport.

HYPNUM CHRYSOPHYLLUM.—On a wall in Eastham Wood. F. P. M.

HYPNUM STENOPHYLLUM, (Wilson's MSS.)—New species. Floating on a pond, Simon's Wood Moss. F.P.M.

HYPNUM SPECIOSUM.—This rare species was found by some of the Southport botanists, and recognised by Dr. Wood.

To the FAUNA the following additions were communicated by Cuthbert Collingwood, M.B.:—

OCTOPUS VULGARIS.—One was taken in Albert Dock on Sept. 11th, 1854. It was a large specimen, and is preserved in the Derby Museum, whence it is now brought forward by Mr. Moore.

BOTRYLLUS POLYCYCLUS.—A tunicated Mollusk, found amid the Tubularia on the Landing-stage. C. C.

EOLIS RUFIBRANCHIALIS.—At Hilbre. C. C.

EOLIS CONCINNA.—At Egremont, on Laomedea gelatinosa. This species has only once before been found, viz., at Whitley, Northumberland, by Mr. A. Hancock. C. C.

EOLIS DESPECTA.—At Egremont, also on Laomedea. C. C.

EOLIS LANDSBURGII.—Found in the Mersey for the first time. C. C.

ANTIOPA CRISTATA.—At Hilbre. A Mediterranean species, found in the same rock-pool with the next, and completing this curious genus. C. C.

Antiopa hyalina—had been taken for the third time, during this summer, by Mr. Moore; and at the same time a pure *white* Tritonia Hombergii was found. Mr. Alder had never met with the latter of that colour.

Sagartia (Anguicoma) viduata (Gosse.)—Sparingly taken at Hilbre.

Sagartia sphyrodeta (candida) Gosse.—Not uncommon at Hilbre.

These two species have hitherto failed to be recorded.

Caligus diaphanus.—An Entomostracon, found by Mr. Byerley and myself in some numbers upon a specimen of Cyclopterus lumpus taken in the Mersey.

Fredericella sultana.—One of the freshwater Polyzoa found by Dr. Edwards and myself in the Canal, Great Howard-street, beneath the bridges.

Dr. Thomson described Mr. M'Ardle's model of an under-Mersey communication with Birkenhead, by means of an iron tunnel (double tube) sunk in the bed of the river. The model was much admired, and led to a number of inquiries relative to the engineering difficulties and natural obstructions in the way.

Professor Archer drew attention to an extraordinary letter which had appeared in the *Athenæum*, describing the discovery of Gothic architecture in the new-red sandstone. The fact was, that an impression of a fucoid plant had been mistaken by the non-scientific writer.*

Dr. Edwards then delivered a lecture upon the progress of Electrical Science; directing his attention mainly to that feature in its progress which was dwelt upon in the inaugural

* The origin of these impressions, which so much resemble the plant,—a drawing of which may be obtained from the Secretary—formed the subject of debate on several subsequent occasions, the general opinion being that they were water runs, and not of vegetable origin.

address of the President, in reference to the recent progress of all departments of knowledge:—namely, to the breaking down of those boundaries between departments of science which had been set up by early discoverers, and framed into systems, which were supposed to be as imperishable as the truths which they embraced.

Experiments were shown, by means of a powerful plate machine, magnets, voltaic batteries, and a Rumkorff's induction coil, illustrating the production of the various forms of attraction from the latter instrument, which was worked by a small Grove's battery. Electricity was also passed through rarefied air and other attenuated gases, showing some important illustrations of phenomena observed in the atmosphere.

At the close of the lecture, a cordial vote of thanks was offered to Dr. Edwards, for his instructive communication and extremely interesting experiments; to Mr. M'Ardle for the exhibition of his model; to Messrs. Elkington and Co. for the valuable bronzes sent up to the Gallery of Ancient Art; to Mr. Foard, Mr. Scott and Mr. Ferranti, for the exhibition of their delicate photographs; and to Mr. Moore for the exhibition of several living salamanders, several gold fish from Japan, and an interesting collection of well-mounted skeletons.

At this meeting the following were elected Ordinary Members:

Mr. F. W. Bloxam,
Mr. Thomas Batty,
Mr. Charles H. Clark,
Mr. James Birch,
Mr. Thomas J. Moore.

FOURTH ORDINARY MEETING.

Royal Institution, 14th November, 1859.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

A Supplemental part of "Gould's Birds of Australia," and an additional part of the "Mammals" were laid upon the table, and it was announced that the valuable gift of Works on Art, from his Imperial Majesty, Napoleon III., had arrived. There were altogether 124 volumes presented to the Royal Institution by the Emperor of the French.

Mr. Morton, F.G.S., submitted a slab of New-red sandstone, taken from a spot between Parkhill-road and the Dingle, bearing marks of abrasion by the passage of a heavy body, which he believed to have been ice, and made the following remarks on—

TRACES OF ICEBERGS NEAR LIVERPOOL.

The New-red sandstone in this neighbourhood is usually covered with deposits of hard clay, containing rounded stones of all sizes, from that of a pea to such as are five or six feet in circumference, and sometimes scratched and polished. There are also beds of sand and gravel containing shells, which are generally beneath the clay. The whole of these deposits are referred to the Boulder-clay, or Northern-drift. It is assumed that the clay, sand, gravel, and boulder-stones were all dropped from melting icebergs as they descended from more northern latitudes. I am not aware that we have hitherto had any other evidence of icebergs in this district than that afforded by the boulders, though that evidence is very conclusive. During the month of May last my attention

was called to the subject by indications of ice grooves and furrows on the high ground between Parkhill-road and the Dingle. The sandstone rock belongs to the conglomerate beds of the Bunter-sandstone. The strata dip 10° E. The striated surface has been covered by nine feet of boulder-clay, part of which was removed some years ago for brick making. The specimen exhibited shows the strongly marked parellel lines and deep grooves which extend across it. The surface from which it was obtained dips 5° N.E. The direction of the lines is N.W. by N., or more correctly, N. 42° W., allowing twenty-four degrees for variation. About ten yards were at first visible; but by employing a labourer to clear away some of the clay, at least twenty square yards have been observed; and no doubt the same appearances extend over a considerable extent of surface beneath the boulder-clay. If this worn surface resulted from the action of ice, it must have been from the grounding of icebergs, as they passed over the portion of rock upon which it is found. In the valley beyond Eastham the boulder-clay contains many fragments of this sandstone, which seem to have been derived from the high land already alluded to, and afford further indications of the direction of the prevailing currents in the glacial sea.

The slab which illustrated this communication has been deposited in the Public Museum.

Professor ARCHER drew attention to the evidences of glacial action on the Cheshire coast. At the Eastham shore, in the direction of Mr. MORTON's lines, there were indications of the deposit of icebergs in the long lines of red clay which were so characteristic of the northern drift. There were evidences likewise at Stourton, in deposits made from the hills of Cumberland. These, however, were from boulders, and not markings in the sandstone, as Mr. MORTON had found in the Parkhill-road, Liverpool.

The following paper was then read—

ON THE COMMON, OR FALLOW DEER, OF GREAT BRITAIN.

BY RICHARD BROOKE, Esq., F.S.A.

Of the numerous species of Deer, known to Naturalists, there are only three to be met with in Great Britain; the Stag or Red deer,* *Cervus elephas;* the Common or Fallow deer, *Cervus dama;* and the Roe deer, *Cervus capreolus.* They are handsome and interesting animals and are much valued and protected, both on account of their symmetry and beauty, and of their conducing to the pleasures of the chase. The Roe remained wild in England and Wales, certainly as lately as in the reign of Henry VIII.† and we have some evidence at least, of its being still here in that of Elizabeth;‡ but it is not now found in any part of this country, to the southward of Scotland.

The Common or Fallow deer, is distinguishable from the Stag or Red deer, in consequence of the superior size of the latter, and of its horns being round throughout their whole length, whilst the horns of the Fallow deer are flattened or palmated in most parts.

This is the species which is found in some of the forests of England, and is so abundant in the parks of our nobles and gentry, and of which the venison is so much esteemed at

* Formerly the male was often called the Hart, especially in ancient grants and legal instruments. In the Act of Resumption passed in the 33rd year of Henry VI. (1455), it was declared, that it should not be prejudicial to the Letters Patent, granted by the King, to the Archbishop of York, to take during his life, "in our Forest of Shirwoode, VI. Stagges otherwise callyd Hertes." Rot. Parl. 33rd Henry VI. (1455), vol. v. fo. 303; and also in the Act of Resumption, of the 13th year of Edward IV. (1473), it was enacted, that it should not be prejudicial, to his grant made to Katherine Fitz William, of a "Tonne of Wyne, and a Stagge of an Hert." Rot. Parl. 13th Edward IV. (1473), vol. vi. fo. 98.

† Leland's Itinerary, vol. vii. pp. 16 [28], 63 [81].

‡ Coke's Institutes of the Laws of England, 4th Part, c. 73, vol. vii. p. 289 [316].

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table. The male of this animal is called a buck, the female a doe, and the young one a fawn.

It is admitted by naturalists, that the Stag and the Roe are indigenous to Great Britain; but in several works of repute, considerable doubts have been expressed whether that is the case with respect to the Common or Fallow deer, and some suggestions have been thrown out that it has been brought from a warmer climate.

Pennant in his *British Zoology*, does not enter upon that question, but observes, that in England, there are "two varieties of Fallow deer, which are said to be of foreign origin, the beautiful spotted kind, and the very deep brown sort, that are now so common in several parts of this kingdom. These" [meaning it is to be presumed the deep brown sort], "were introduced here by King James the first, out of Norway,* where he passed some time when he visited his intended bride Mary of Denmark. He observed their hardiness, and that they could endure, even in that severe climate, the winter without fodder. He first brought some into Scotland, and from thence transported them into his chases of Enfield and Epping, to be near his Palace of Theobald's."†

Goldsmith gives an account similar to that of Pennant, to whose work he refers; and also mentions, that James the first introduced the deep brown sort from Norway, and adds—"since that time they have multiplied in many parts of the British Empire; and England is now become more famous for its venison than any other country in the world."‡ He also states that the beautiful spotted kind is supposed to have been brought from Bengal.

* Pennant's Brit. Zoology, vol. i. p. 39. He also adds in a note "This we relate on the authority of Mr. Peter Collinson;" but Pennant does not give any information whether it is taken from any published work, or obtained by personal communication; a slovenly mode of writing, because we are by that course prevented from investigating and judging of the accuracy of the statement.

† Pennant's Brit. Zoology, vol. i. p. 39.

‡ Goldsmith's History of the Earth, and Animated Nature, vol. iii. p. 129.

Whitaker in his *History of Whalley*, devotes some pages to an account of the unreclaimed or partially reclaimed animals formerly in that part of the country, and adverts to the before mentioned passage from Pennant's work; and with some appearance of doubt and indecision, states that "another species of deer seems to have been introduced," of which, though it is become the most numerous of the whole genus, &c., the history is very obscure—"this is the common Fallow Deer." In a subsequent passage he throws out the enquiry, "Can any evidence be adduced to prove that they were imported by the later Crusaders from the East?"*

Bell in his *History of British Quadrupeds*, in describing the Fallow deer, makes the following observations—"Whether it may be considered as indigenous to this country, or whether introduced at some remote period, appears to be a question which the lapse of time, and the absence of sufficient historical testimony renders difficult, if not impossible of solution, and one upon which the most diligent search which I have been able to make has not thrown the smallest light. The circumstances which lead to the latter opinion, are its restriction in this country solely to places which have been set apart for its reception, and the strong evidence which exists both from the known foreign habitats of the species, and from its comparative intolerence of our winters, that it must have been originally transplanted from a more genial climate. In this respect its habits differ essentially from those of the hardy Stag and Roebuck, which brave the cold of even Scottish winters and live and flourish through them without the care and tendance of man. It is probable that it was brought to this country from the South of Europe, or from the Western part of Asia, in which places it is found to attain to a larger size than in its semi-domesticated state in our parks."† In

* Whitaker's History of Whalley, 3rd edit. book iii. c. iv. pp. 199, 200.

† Bell's History of British Quadrupeds, p. 403.

considering this passage it ought to be noticed, that although Bell does not positively assert that the British Fallow Deer is of foreign origin, yet his opinion is evidently strongly in favour of its not being indigenous here, but that it came from some warmer country. He labours under a great error, if he supposes that the Fallow deer cannot live in England during the winter, "without the care and tendance of man." I have met with elderly persons in Nottinghamshire, who recollected the deer living in Sherwood Forest, where they did not receive attention of that description from man; and I cannot doubt that the same remark applies with equal truth to Fallow deer now living in other forests or places.

In Rees's Cyclopedia, (published in 1819), it is stated that "The Common deer is more preserved in England than in any other part of the world, and carries its distinction from the Red deer in its size, and in the falcated figure of its horns. They are said to have been first introduced here by King James the I., out of Norway, who first brought them into Scotland, and from thence into his chases of Enfield and Epping. They are scarcely known in France, but are sometimes found in the North of Europe."*

Unless in the foregoing passage some particular breed or colour of Fallow deer is meant, it is clear that it is erroneous to convey the idea that those now in this country came from Norway.

In the *Encyclopædia Britannica*, (8th edition), it is stated that "The Fallow deer, *(Cervus dama, Linn.)* of our inclosed parks, is now scarcely known except in the domestic state. Some incline to regard it as originally an African species, in consequence of an individual having been shot some years ago, apparently wild, in a wood to the south of Tunis;" and also "and it may perhaps militate against the

* Rees's Cyclopedia, vol. xi. title "Deer."

introduction from Norway of our darker brown variety, that Pontoppidan in his Natural History of that country, makes no mention of Fallow Deer of any hue whatever."*

It would have been much more satisfactory, if the writers who have asserted that there had been such an importation of dark brown deer by James the I., from Norway, had referred to some author of known reputation, who had written in the time of James the I., and who had mentioned such a circumstance. I have, in the course of my life, occasionally passed a good deal of time in the immediate vicinity of Parks, where there were considerable numbers of Fallow deer, of all the usual shades of colour from dark to light, and I have known them suffer very severely from cold and want of food; I have even known some to perish from those causes, yet I had no reason to suppose that such of them as were of a dark colour could withstand the rigour of our climate better than those of the usual brown or fawn colour; besides which from the great numbers of a very dark hue which are to be seen in our parks, as well as from their colour not being so pleasing to the eye as that of some others, and consequently not offering the same inducement for their propagation, we may reasonably doubt the truth of the statement that the dark coloured deer imported from Norway, were the original stock from which we have derived the numerous dark brown ones, now so plentiful in this country. That is, however, a point of secondary moment; the important point for consideration, being whether the Fallow deer is indigenous to Britain or not.

It has been urged by more than one person of great talents and research, that although the horns of the stag have often been found in excavating the earth, those of the Fallow deer have never been so discovered in this country; the former position may readily be admitted, and amongst many other

* Encyclopædia Britannica, 8th edition, (1857), vol. xiv. pp. 207, 208.

instances, I may mention that those of the stag have been found not many years ago, both on the site of the Old Dock of Liverpool, where Revenue Buildings now stand, and on the opposite side of the Mersey, in the excavations in the bed of Wallasey Pool. Even if it were a certain and well-authenticated fact, that the horns of the Fallow deer have never been dug up under similar circumstances, still that appears to me not to be conclusive to decide the point; and I cannot say that I am quite satisfied that such a fact is ascertained. In the additions to "Camden's Britannia," by Gough, title "Orkney,"* it is stated that "Deers' horns are found in Hora Parish;" and also "at the Burgh of Burnis have been found Deers' bones and Limpet shells."

It may perhaps not be considered foreign to the subject, to mention, that in Gough's additions to "Camden's Britannia," it is stated that there were discovered in 1760, in Northumberland, a curious and beautiful stone relief of a Roman soldier in a niche, armed with a spear and shield, above his left shoulder, a lion recumbent, and a deer under it;† and also a large altar of white ragstone, two feet thick, with a deer in the centre leaning against a tree, and two fawns below.‡

It is my intention to endeavour to shew, by a reference to various authorities, all of which are of authenticity, and some of which are of remote antiquity, the existence in this country of the Fallow deer, so commonly, and under such circumstances, as seem to be irreconcilable with the theory of its having been imported from any foreign place. In doing so, it will be observed, that the words "deer," and "venison," occasionally occur in the quotations and references which appear in this paper. The word "deer" possibly may apply equally to the Red deer, Roe deer, and Fallow deer; and the word "venison" may also with equal propriety be ascribed

* Camden's Britannia, Gough's edition, vol. iii. p. 724.

† Ibid. vol. iii. p. 244. ‡ Ibid. p. 245.

to the flesh of all these species of deer; but I venture to think that whenever these words are used, referred to, or quoted in this paper by any of the authorities, there is good reason to believe that under the circumstances in which they occur, a limited construction ought to be given to them; and that in the absence of any explanation, or of any thing in the text, repugnant to such a construction, we are fairly justified in ascribing them to the Fallow deer, or to its flesh, as the case may be. In such cases it is not possible to lay down any infallible rule of construction, and it must of course be left to each reader, to form his own opinion as to the precise meaning of the words in the instances where they occur.

The following references to authorities are arranged as nearly as may be, in chronological order.

The Abbey of Fors, in Wensleydale, in Yorkshire, was founded in the eleventh year of the reign of King Stephen, (1145) and afterwards, Alan, Earl of Bretagne, gave to the Monks of that Abbey, the privilege of taking by themselves or their servants, the remains of the deer which had been killed and partly devoured by wolves in the forest of Wensleydale.*

At first sight, this may possibly seem to have been a strange privilege to be granted to the monks of Wensleydale, but it ought to be borne in mind, that in the mediæval ages, deer furnished no inconsiderable portion of the food of numbers of people in England, and that it might easily happen, that in some seasons, the monks were happy to obtain the carcases of deer, which had been killed by wolves. "Before the natural pastures were improved, and new kinds of fodder for cattle discovered, it was impossible to maintain the summer stock during the cold season. Hence a portion of it was regularly

* Whitaker's History of Richmondshire, vol. i. p. 409. Whitaker's History of Whalley, 3rd edition, p. 200, (note) referring to "Burton's Monast. Ebor.," under the head "Fors Abbey."

slaughtered and salted for winter provision. We may suppose that when no alternative was offered but these salted meats, even the leanest venison was devoured with relish. There was somewhat more excuse, therefore, for the severity with which the lords of forests and manors preserved the beasts of chase, than if they had been considered as merely objects of sport."* Besides which, although it may not be altogether agreeable to our notions, to partake of any animal of which wolves have eaten a portion, yet we know from the narratives of navigators and travellers in the arctic regions, that it has frequently occurred, that persons visiting those parts have gladly availed themselves of, and eaten the flesh of deer partly devoured by those ravenous beasts. Instances of it are mentioned in Dr. Armstrong's *Narrative of the Discovery of the North-West Passage*, during the voyage of H.M.S. "Investigator," of which he was the surgeon and naturalist. In one of the instances the boatswain (Mr. Kennedy), on going on shore in April, 1852, to fetch a deer which he had killed on the preceding day, finding a pack of five wolves devouring it, courageously advanced to them, shouting loudly in hopes of intimidating them and obtaining assistance, and seized the deer whilst one of the wolves persevered in also holding it with his teeth. Assistance however arriving, the wolves retired, and he was enabled to carry off the remains of the deer in triumph, and he had a portion given to him for a reward, and the remainder (14 pounds), was added to the general stock of the ship's provisions. On another occasion, in March, 1853, a party was despatched from the vessel for a deer shot on the previous day, and they found a large wolf feeding upon it. The wolf was shot by one of the party, and Armstrong states that its carcase contributed to the stock of food of the crew, and the meat of it was considered very

* Hallam's State of Europe, during the middle ages, vol. ii. p. 374.

good,* and preferable to bear's flesh. Armstrong does not inform us what was done with the remains of the deer recovered from the ravenous brute; but as we are told by him that the flesh of the wolf was used for the food of the crew, we cannot reasonably doubt that such portion of the deer as was so recovered, was disposed of in a similar manner.

In the reign of Richard the first, or in that of John, (the exact date is uncertain), John Fitz Peter gave to the monks of Pontefract, two oaks every year, against Christmas, in his wood of Birkin, and one buck in his park, in the feast of Saint before the Port Latin, and half the mill of Stainburg, &c.†

In the ninth year of Henry the third, (1235), the Charter of the Forest was passed, with the humane intention of mitigating in some degree, the barbarities of the Forest Laws, introduced by the Normans. It enacts in chapter 10‡ that no man shall lose life or limb for killing the King's deer, but that if any man be taken, and convicted of that offence, he shall be fined and imprisoned; ["vitam vel membra pro venatione nostra, set si quis captus fuerit et convictus de captione venationis, etc, etc.;'] and in chapter 11, it is enacted that it shall be lawful for any Prelate or Nobleman coming to the King, and passing by a Royal Forest, to kill one or two deer ["unam bestiam vet duas,"] in view of the Forester, if he be present; or if not, then after the ceremony of blowing a horn in order to shew that he was not stealing the deer. It may be admitted that the words in mediæval Latin, "pro venatione nostra," and "venationis," in chapter 10 of the Act, are not altogether conclusive, but

* Armstrong's Narrative of the Discovery of the North-West Passage, c. 20, p. 511, c. 22, p. 556.

† Thoroton's Antiquities of Nottinghamshire, p. 375.

‡ Charta de Foresta in the Statutes at Large, 9th Henry III., (1225), chap. 10.

they are considered by Sir William Blackstone* and other eminent writers to mean the King's deer; and in the English copy of the Act, printed in the Statutes at Large the words "our Deer" are introduced.†

In the twentieth year of Henry the third, (1235), John, Earl of Huntingdon, obtained a grant from the King of ten bucks and ten does out of the forest of Rockingham, in Northamptonshire, to store his park at Fotheringay.‡

In the fifty-fifth year of Henry the third, (1270), amongst a number of other trespassers, the Abbot of Chester was charged with having taken two does. §

In the thirteenth year of Edward the first, (1284), a Charter was granted, which allowed the Abbot of Chester and his successors to take six bucks and six does ["sex Damos et sex Damas"] at certain seasons in the King's Forest of Cheshire.||

In the thirty-first year .of Edward the I., (1292), legal proceedings by Quo Warranto were prosecuted against Richard Done, of Utkinton, the Chief Forester of the Forest of Mara and Mondram, (now called Delamere), in Cheshire, relative to the jurisdiction of the Forest exercised by him; and in his plea, he claimed to have "the right shoulder of everie deer taken; and claymath if any stroken deer be found dead in the sayde forest, that he shall cause the hornes, and the tow sides of the said deer to be sent to the Castell of Chester, and the Foresters to have the residue of the same."¶

In the thirty-third year of Edward the I., (1304), by a

* Blackstone's Commentaries, 21st edition, vol. ii. p. 415. Whitaker's History of Whalley, 3rd edition, p. 196.

† Charta de Foresta in the Statutes at Large, 9th Henry III., chap. 10, Ruffhead's (King's printer), edition.

‡ Dugdale's Baronage, vol. i. p. 610.

§ Ormerod's Cheshire, vol. ii. p. 53, referring to Harl. MSS., 2060–76.

|| Ibid. Vol. ii. p. 53, referring to Harl. MSS., 2971, 756.

¶ Ibid. Vol. ii. p. 51, referring to Harl. MSS., 2115, 232, and stating that the original plea is enrolled in the Exchequer of Chester.

mandate to Richard Done, the Foresters were commanded to permit the abbots to take the deer themselves, to the number of a stag and six bucks yearly, and to carry them away, with such chance does or wild beasts as might be killed among them.*

The Forest of Inglewood formerly so abounded in venison, that King Edward I., during a few days which he spent in Cumberland, for the purpose of hunting, is said to have killed 200 bucks in it.† The Prior and Convent of Carlisle had the tithe of venison in this forest.‡

In the thirteenth year of Edward II., (1319), a presentment occurred of twelve individuals who hunted with hounds and horns, on the Sunday before the Feast of St. Thomas, destroyed the deer in the forest, in Cheshire, and finally joined in an affray with Thomas de Barewe and John Bradley, keepers.§

In the twenty-seventh year of Edward III., (1352), pardon was granted to Richard Done and Edward Frodsham, for killing Robert Cosyn, taken in the fact of slaying one of the deer.||

In the early part of the fourteenth century there were not less than fifty-four deer parks in Derbyshire, of which the names are given by Messrs. Lysons.¶

In the ninth year of Edward III., (1335), a petition in Norman-French, to the King in Parliament, was presented from persons connected with the Forest of Macclesfield, in Cheshire, complaining that Thomas de Hompton, bailiff of Macclesfield, had taken or given the King's venison in the

* Ormerod's Cheshire, vol. ii. p. 53, referring to Harl. MSS., 2060–76.

† Lysons' Mag. Brit. (Cumberland), vol. iv. p. 100, referring to Chron. Lanercost.

‡ Ibid. Referring to Prynne's Records, vol. iii. p. 672.

§ Ormerod's Cheshire, vol. ii. p. 53.

|| Ibid. Vol. ii. p. 53.

¶ Lysons' Mag. Brit. vol. v. p. 169.

said forest [" vostré veneison en la diste Foreste,"] as stags [" serfs,"] deer [" deyms,"] &c., to the number of xxiv. and more.*

A petition in Norman-French, of the twenty-first year of Edward III., (1347), is in the Parliamentary Rolls, praying that no person shall be allowed to chase or kill the deer [" sauvagine"] strayed from the King's forests, except the owners of the woods or soil where the deer [" sauvagine,"] may be found.† The word here used "sauvagine" is now gone by, and almost forgotten, but it appears to have been an ancient Norman-French word for deer or venison.‡

Another petition in Norman-French, in the reign of Edward the III., (date uncertain) was presented from the King's Tenants and Commonalty of Bowland, in the Counties of Lancaster and York, complaining that Adam de Clitheroe, with 300 armed men or more, killed and took away at their pleasure, the King's venison, [" la veneson nr̃e dit Seignr̃ le Roy,"] and committed other depredations.§

In the thirty-third year of Henry VI., (1455), the Abbot of the Monastery of our Lady of Abingdon, and the Convent of the same place had the privilege of taking, in certain places, twenty bucks and does, in exchange for the tithe of venison in the Forest of Windsor, and the Parks within the same.||

* Rot. Parl. 9th Edward III, (1335), v. ii. fo. 94.

† Ibid. 21 Edward III., (1347) vol. ii. p. 174.

‡ In Cotgrave's French Dictionary, of 1660, it is stated to mean "venison." It probably also applied to the Stag, Fallow deer, Roe deer, and Wild boar.

§ Rot. Parl. Edward III., vol. ii. fo. 390. Pennant in his British Zoology, vol. i. p. 38, states that—"It was customary to salt the venison for preservation like other meat. Rymer preserves a warrant of Edward III., ordering sixty deer to be killed for that purpose." Pennant has unfortunately omitted to refer to the year of the reign of Edward III. in which it is said to have occurred, or to the volume or page where the Warrant is supposed to be copied; and in the absence of that information, it must be admitted that a diligent search for it in the Fœdera, would be rather too laborious an undertaking, because Edward reigned fifty-one years, and the documents of his reign occupy some folio volumes. It is therefore difficult to say what description of deer Pennant has alluded to in that passage.

|| Rot. Parl. 33 Henry VI., (1455), vol. v. fo. 307.

Although it has been already mentioned, that the word "venison" has been applied to the flesh of other kinds of deer, as well as to that of the Fallow deer, yet in the instance just mentioned, it cannot well be doubted that it was clearly intended to be confined to that of the Fallow deer.

In the same year, Sir Thomas Stanley held by Letters Patent, the Grant or Lease of some ground, herbage and pasture, within the forest of Macclesfield, which he had taken for the preservation of the deer in the forest.*

In the same year, Henry Roos, son and heir of Robert Roos, had the overlooking of Vert and Venison of all the Parks and Bailiwicks within the Forest of Rockingham.† The words "vert and venison," frequently occur in ancient grants, charters and documents, connected with the forests of England; the latter word means the deer, and the former the trees and everything that bears foliage, and may serve as cover for the deer. Vert, a word also sometimes taken for that power, which a man hath by the King's grant, to cut green wood in the forest.‡

In the fourth year of Edward the IV., (1464), Ralph Hastings and William Lord Hastings, had the overlooking of the vert and venison of the forest of Rockingham.§

In the same year, Piers Curteys and William Trussel, had the privilege of the loppings and croppings of wood fallen within a place called the "fryth of Leicester," for the browsing of the deer there.||

In the reign of Edward IV., (the exact date uncertain,) he granted to Lady Alice Savile, widow of Sir John Savile, a tun of red wine, a red deer, ["a Redd Dere called an Hert,"] two bucks and two does; and the Act of Resumption,

* Rot. Parl. 33 Henry IV., (1455), vol. v. fo. 312. † Ibid. fo. 319.
‡ Burns' Law Dictionary, vol. ii. p. 404.
§ Rot. Parl. 4 Edward IV., (1464) vol. v. fo. 533. || Ibid. fo. 547

of 1st Henry VII., (1485), is declared not to be prejudicial to her right to them.*

In July, (1471), Edward IV., went to hunt in the Forest of Waltham, whither he invited the Lord Mayor of London, and others, to accompany him; and the King "caused the game to be brought before them, so that they sawe course after course, & many a dere, both rede and falowe to be slayne before them."†

In August following, the King "sent unto the Mayresse, and her sisturs, Aldermennes' wyfes, II. hertes and VI. bukkys, with a tonne of wyne to drynke with the sayde venyson."‡

In the the twenty-second year of Edward the IV., (1482), an Act was passed respecting injury done by the improper cutting of wood, within the Forest of Rockingham, and other forests, chases and purlieus, to his deer, vert and venison, ["sou dere vert & venison."]§

In the eleventh year of Henry the VII., (1495), George, Earl of Shrewsbury, held the office of Mastership of the Leader of the deer of the Park of Oakley, and also of the Leader of the deer of certain chases in the Marches of Wales.||

In the reign of Henry the VIII., there were a vast number of forests, chases and parks, in England, containing Fallow Deer. Leland, the Antiquary, in his Itinerary, written in the reign of Henry VIII., repeatedly mentions them, as well as Red Deer, and in two instances the Roe Deer also; as will be observed in the following extracts from his work.

The Park of Aukland Castle "having Falow Dere, wild Bulles and Kine."¶

* Rot. Parl. 1 Henry VII., (1485), vol. vi. fo. 373.

† Fabyan's Chronicles, fo. 227, [667.] ‡ Ibid, fo. 227, [667.]

§ Statutes at large; Ruffhead's (King's printer), edition, 22nd Edward IV, c. 7.

|| Rot. Parl. 11 Henry VII. (1495), vol. vi. fo. 470.

¶ Lel. Itin., vol. i. fo. 79, [72.]

At the Castle of Raby; "ther long 3 parkes to Raby, wherof 2 be plenished with Dere." Langley Chase "hath Falow Dere." "The King hath a Forest of Redde Deere yn the More Land, at Midleton."*

At Pederton Park, near Athelney, "There ys a great numbre of Dere, longging to this Park, yet hath it almost no other enclosure but Dikes." "The Dere trippe over these Dikes, and feede al about the Fennes and resort to the Park agayn."†

"From Cannington to Stowey, 3 good miles." "Stowey is a poore village," etc., etc., "and having by it a Parke of Redde Deere, and another of Falow."‡

"From Colehow, aboute a mile beyond, upper by South West, on Severn, is St. Dinothes, a Castel. It stondith on a meane hille, a quarter of a mile from the Severn Se. In the which space betwixt the Castelle and the Severn is a Parke of Falow Dere. There is a nother Park of Redde Deere more by Northe West from the Castelle."§

At the Castle of Hertlebury, in Shropshire, "Ther is a Parke and Deere, a warren for Conyes," etc.‖

Near Whitchurch, in Shropshire, the Park of Blackmere, belonging to the Earl of Shrewsbury, "hath both Redde Dere and Falow."¶

In the Forest of Delamere, in Cheshire, "entering a 2 miles within the Forest, having Redde Deere and Falow." "In the Forest I saw but little corne, bicause of the Deere."**

"Almost a mile or I cam to Pipwel, I enterid into the Woode of Rockingham Forest." "No Redde Deare but Falow in Rockingham Forest. The fairest game of the Forest is seene at a place in the Forest caullid Launde of Benefeild."††

* Lel. Itin. vol. i. fo. 92, [84.]

† Ibid. vol. ii. fo. 56, [66.]

‡ Ibid. vol. ii. fo. 59, [68.]

§ Ibid. vol. iv. fo. 65, [45.]

‖ Ibid. vol. iv. fo. 183, [102.]

¶ Ibid. vol. v. fo. 81, [85.]

** Ibid. vol. v. fo. 82, [86.]

†† Ibid. vol. v. fo. 94, [107.]

Clune Castle, 7 miles from Montgomery and 10 from Ludlow, had near it "a great Forest of Redde Dere and Roois, longinge to the Lord of Arundell."*

Leland also mentions the existence of the Roe Deer elsewhere. "In Northumberland, as I heare say, be no Forests excepte Chivet [Cheviot] Hills, where is much Brushe Wood, and some Okke, grownd over with Linge, and some with Mosse. I have hard say that Chivet Hilles stretchethe xx miles. There is greate plenty of Redd Dere and Roo Bukkes."†

Between Lichfield and Wolverhampton, "There is a Chace Grounde yn Staffordshir, having Deere, caullid the vii Hayes."‡

The Forest of Needwood, near Tutbury "is mervelusly plenishid with Dere."§

In the Forest of Delamere, "There is plenty of Redde Deere and Falow."||

At Acton, "Is a goodly Howse and 2 Parks by the Howse, one of Redd Dere, and an othar of Fallow."¶

In the reign of Queen Elizabeth, Sir Edward Coke, afterwards Lord Chief Justice of England, and from that circumstance often called Lord Coke, was a Lawyer of great talents and learning, and was made her Solicitor-General in 1592, and her Attorney-General in 1594. In his celebrated work, "The Institutes of the Laws of England," he devoted considerable labour to his account of our Forest Courts, and the animals to be met with in the Forests of England. In that work he states, that, "the Forester or Keeper may arrest any man that kills or chaseth any Deer within the Forest."**

* Lel. Itin. vol. vii. fo. 28, [16.]

† Ibid. vol. vii. fo. 81, [63.]

‡ Ibid. vol. vii. fo. 37, [26.]

§ Ibid. vol. vii. fo. 38, [27.]

|| Ibid. vol. vii. fo. 42, [30.]

¶ Ibid. vol. vii. fo. 74b, [94.]

** Coke's Institutes of the Laws of England, 4th part, c. 73, vol. vii. p. 289, [290.]

"There be many beasts of the forest by the laws of the forests of England. The hart in summer, the hinde in winter, and all that proceed as of them; the buck in summer, the doe in winter, and the proceed of them; the hare, male and female, and their proceed; the wild boar, male and female, and their proceed; and the wolf, male and female, and their proceed; the martin, male and female; capreolus, the roe, as it appeareth before, is no beast of the forest, but it is a beast of chase."*

"The proceeds of the buck and doe: the first year a fawn, the second year a pricket, the third a sorell, the fourth a sore, the fifth a buck of the first head, the sixth a great buck. * * The seasons, by the laws of the forest, for the beasts of the forest are these:—of the hart and the buck, beginneth at the feast of St. John Baptist, and endeth at Holy Rood day; of the hinde and doe beginneth at Holy Rood, and continueth till Candlemasse; of the fox at Christmasse, and continueth till the 25th of March; of the hare at Michaelmas, and lasteth till Midsummer; of the bore from Christmasse till Candlemas. * * * In the Statute of Carta de Foresta, in divers places, *venatio* signifieth venison, in French *venaison*, and so in effect in Dutch and other languages. * * * So as the red-deer, the fallow-deer, the wild boar, and the hare, are venison."†

It does not appear to me to be requisite to adduce more modern evidence respecting the Fallow deer, and I therefore do not pursue that topic after the reign of Elizabeth.

I had occasion to refer to the work of Coke, "On the probable period of the extinction of wolves in England,"‡ in a former paper, which I read before the Literary and Philosophical Society of Liverpool, in order to show that both in the

* Institutes of the Laws of England, p. 315, [316.] † Ibid. p. 316, [316.]

‡ The paper is published in Brooke's "Visits to Fields of Battle in England, of the 15th century; to which are added some miscellaneous Tracts and Papers upon Archæological subjects;" and also in the Proceedings of the Literary and Philosophical Society of Liverpool, 46th Session, 1856-57, No. XI., p. 61.

passage just quoted and elsewhere, he had mentioned the wolf as being a beast of chase in England in the reign of Elizabeth ;* and upon that occasion I drew the attention of the Society to the circumstance that he used the present tense in writing of it, which it is not likely that he would have done, if he had intended to write respecting an animal which had formerly been in England, but which had ceased to exist there. It is, however, very probable that it had then become extinct in most parts of England, but that it was then to be met with in some few of the northern counties, especially in such of them as were not very distant from Scotland, in which kingdom wolves were then very numerous.†

Whilst upon that subject, it perhaps may not be considered an unreasonable digression, if I here mention two additional proofs of the existence of wolves in England, long after the period when some writers have stated that they had become extinct.‡

In the reign of King John, in consequence of some mutual arrangement, the legal ceremony of levying a fine, as it was termed, took place between William de Mowbray and Adam de Staveley.

"Hæc est finalis concordia inter Wil. de Mowbray et Adamum de Staveley; nempe quod prædictus Adam recognovit prædicto Wilhelmo totam forestam suam in Lonsdale, cum pertinentus, liberam et quietam, adeo ut omnes feræ silvestres & aves alias capientes remaneant prædicto Wilhelmo in perpetuum. Secundum autem quod prædictus Wilhelmus

* Sir Edward Coke was a lawyer of great eminence not only in the reign of Elizabeth but also in that of James I., and lived until after the accession of Charles I.; but the exact time when he wrote the work alluded to does not appear to be well ascertained. It is not improbable that he commenced it in the reign of Elizabeth, but did not complete it until afterwards.

† See Holinshed's Chronicles, Description of Scotland, vol. iii., p. 14. Camden's Magna Britannia, Gough's edition, vol. iii. pp. 10, 445.

‡ The paper was published in Brooke's "Visits to Fields of Battle in England, of the 15th century," &c.; but the two additional proofs respecting the existence of wolves, above mentioned, were omitted to be noticed in it, they having escaped my observation until after the work had issued from the press.

de Mowbray concessit prædicto Adamo & heredibus ejus, de dono suo, quod capere possit leporem & lupum cum canibus in prædicta foresta."*

Here the right of destroying the wolf with dogs in a forest of Lonsdale is distinctly mentioned. Whitaker, in commenting upon it, states, "This seems to have been a kind of partition of the rights of free chase, between these two chieftains, by which Mowbray, the chief lord, reserved to himself the stag (which I suppose is meant by fera silvestris) and the hawk; while the mesne lord was contented to chase the hare, and, what was then accounted a privilege, to destroy the wolf. At so late a period was that formidable animal found in the Wapentake of Ewecross."†

In the reign of Henry III., the manor of Laxton, in Northumberland, was held by the tenure of the possessor of it chasing wolves with dogs.‡

With respect to the common or Fallow deer, from the number of instances which have been here adduced, and many other authorities might be referred to, (if it were worth the time and labour of doing so,) of its existence in this country so commonly and at such remote periods back, it seems scarcely credible that it could have been an animal imported from abroad.

There is an important point which ought not to be overlooked by persons who suppose that it was imported from Asia or Africa. Consider the contemptible state of the commerce of this country in ancient times; there is not any

* Whitaker's Richmondshire, vol. ii. p. 354. The forest above-mentioned, is presumed to be at Thornton in Lonsdale, or Burton in Lonsdale, in the Wapentake of Ewecross, in the West Riding of Yorkshire, near Kirby Lonsdale, and on the confines of Lancashire and Westmoreland, a district where the Mowbrays once held great possessions; it is also in the neighbourhood of the extensive forest of Bowland, in a part of the country then thinly inhabited, and where it is very credible that wolves would be met with, after they had become extinct in many other districts.

† Whitaker's Richmondshire, vol. ii. p. 354.

‡ Brand's History and Antiquities of Newcastle-upon-Tyne, vol. ii. p. 393, (note) referring to an entry in the Harlein MSS., temp. Henry III.

reason to believe, that a single vessel ever sailed between it and those parts of the world, or that we had any trade with them, much before the termination of the Plantagenet or until after the accession of the Tudor dynasty, yet the proofs are abundant of the existence of the Animal here, at a period of remote antiquity in the middle ages. Those who hold the theory of its having been imported, are consequently driven to admit that if imported at all, it must have been brought here either before or soon after the Norman invasion, some centuries before any trade was carried on from hence with those distant parts. In the infancy of navigation, such voyages must have been considered most perilous, if not actually impracticable; and at that time persons of eminence, rank and property, in this country, were too ignorant and barbarous, to incur the trouble and expense of importing foreign animals in order to possess the breed for amusement or profit, and their coarse habits and profound ignorance would render such an importation for the purposes of science or curiosity, almost impossible.

The advocates of the theory seem also unable to refer to any ancient writer or authority, in support of it; nor do they appear able to adduce any proof that the Fallow deer is to be found in Asia or Africa in a semi-domestic state, as is the case in our parks, or under such circumstances as to induce the belief that it was imported from thence; or that it was originally imported into any part of the continent of Europe, and from thence into England. Nor is that all, for even if the animal could be supposed to have been introduced here at so early a period, the violence, insecurity to property, and barbarous manners which prevailed here, in the middle ages, seems to render it scarcely possible, that it could have been allowed quietly to propagate, and multiply to the immense numbers which have existed here during several centuries past.

A considerable number of the forests of England were formerly of vast extent; amongst others may be particularised the Forest of Rockingham, which extended for about thirty miles in length, from Northampton to Stamford, and about eight in breadth, from the river Nen to the Welland and the Maidwell; the New Forest, which extended about twenty-three miles in one direction, and about fifteen in another, and contained about 92,365 statute acres; Bowland Forest, which was of very great extent; the Forest of Sherwood, which extended from Nottingham to the vicinity of Worksop, in length about twenty-five miles, and varying from seven to eight miles in breadth; Inglewood Forest, which was of very great size; and the circumstance has been already mentioned of King Edward I., during a few days which he passed in Cumberland, for the purpose of hunting, having killed 200 bucks in it; and various other forests of great extent might also be mentioned. These forests abounded in prodigious numbers of Fallow deer, which had a vast extent of country to roam in, and were in a wild state, and could not possibly have the advantages of care, nurture, or shelter from man; advantages which were perhaps enjoyed by such of the Fallow deer as were kept in a semi-domestic state in parks. Besides which it may be confidently asserted, that it is not possible to mention an instance of any quadruped, in a wild, or a semi-domestic state, or perhaps even in a domestic state, which is admitted by naturalists to have been originally imported from a warmer climate into this country during the middle ages, having ever multiplied to the immense numbers in which the Fallow deer formerly abounded in it.

From the many proofs which have been here adduced, of the existence of the Fallow deer in England in vast numbers, and at a very remote period, it is submitted that we are quite justified in considering it to be an animal indigenous to this country.

FIFTH ORDINARY MEETING.

Royal Institution, 28th November, 1859.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. James Atkin, was duly elected an Ordinary Member.

Mr. Moore exhibited some fine specimens of the horns of the Red deer, the largest pair being from the shores of the Black Sea. Some fossil portions of the horns of the same animal, found in Wallasey in association with the bones of the *Bos longifrons*, were also exhibited.

Mr. Archer submitted some of the plates illustrative of art by the early Christians, on the walls of the catacombs, from the collection of works presented to the Royal Institution by his Imperial Majesty the Emperor of the French.

Dr. Inman gave some account of a visit he had paid to the catacombs, in the course of which he mentioned having seen the skeletons of a man and woman lying side by side; a somewhat unusual arrangement, as there seemed to be separate halls for males and females.

Mr. Byerley exhibited the remains of a toad, which presented a singular instance of parasitic devastation. Some insect appeared to have deposited its ova in the nostrils of the animal, and the maggots had subsequently eaten away a large portion of the textures while the animal was alive, the eyes being ultimately left on the outside of the head, through the destruction of the surrounding tissues.

The Chairman drew attention to the subject of symmetrical forms supposed to arise from organisms, and referred, as an example, to the cone-in-cone coal, a specimen of which had

been brought before the society on a recent occasion. In that case the peculiar form did not proceed from any living organism, but was purely mechanical. He illustrated his meaning by a circumstance which had accidentally come under his observation in his own house. He had noticed his son playing with a number of toy bricks, ranging them in a line along the floor, in imitation of a railway train, and pushing the row at one end. The effect of the pressure thus applied, was to deflect the further end of the line to one side, until the resistance from friction having reached a certain amount, a similar deflection to the other side commenced, and so on through the entire series. Thus the row of bricks, about 150 in number, fell into a form very much resembling the fronds of a fern. Supposing the same thing to take place with a substance that was elastic and continuous, it might produce a pinnated form. And supposing again that instead of a line, the substance acted upon was a mass, there would not be the same regularity of appearance, but something of the same kind would take place, which might account for the cone-like form of the coal. The inference he wished to draw was, that many apparently organic forms might after all be only the result of pressure in a particular direction, influenced and modified by lateral friction.

Professor ARCHER observed that the cone-in-cone coal was always produced in layers, in which one series fitted into the other just like teeth. It had been suggested that some peculiar vegetable forms had originated the coal in which this remarkable appearance was presented, and which in the change from the organic to the inorganic state had been retained. The *Xanthorea*, or lance-tree of Australia and New Zealand, afforded an example of this. The tuft-like leaves being thrown off, and the bases being left behind, the cavities got filled up with gum, forming a structure very much resembling the cone-in-cone coal.

Mr. MORTON said the same appearance existed in limestone. A paper had been read by Mr. Sowerby at the last meeting of the British Association, which bore upon this subject. The effect, he believed, was attributed to crystalisation.

Dr. INMAN adduced several examples, as common starch, extract of henbane, and sugar, in support of the opinion that the result was due to crystalisation. There might be some salts of lime in the coal, which would have the effect of causing a peculiar disposition of the particles.

Dr. EDWARDS had not the least doubt that it was the result of certain mechanical forces, which were capable of producing forms of almost mathematical regularity, certainly as regular to the naked eye as crystals. Slate was the nearest example. Horizontal and vertical force, when intense, would produce striæ of extreme fineness, so as to give a true cleavage, which would represent the effect of crystalisation. This was proved by the experiments made by Professors Tyndal and Huxley, in their endeavours to ascertain the cause of the curious ribbon lines in glaciers. They submitted ice and snow to such immense pressure that it resembled slate. Following out the idea thus suggested they took slate powder, to which they applied hydraulic power, and found that they had brought it back almost to its original state.

Professor ARCHER remarked, that terrestrial magnetism was to be taken into account as well as molecular attraction. The effects of the magnetism were manifested in the regular lines of the slate. He was reminded by the discussion, of an interesting circumstance in connexion with the geological features of Stourton. A large fracture had occurred in the sandstone, the direction of the cleavage being at right angles to the direction of the strata on each side of the anticlinal axis of the hill. Dr. Buckland and Mr. Cunningham had visited the spot, and felt that it presented a great difficulty. The hill itself was composed of fine sandstone, while the filling up was

very coarse, and the lamina were vertical. Until the observations and experiments of Professor Tyndal, no explanation could be offered. But supposing pressure to be capable of producing the effects ascribed to it, they had the key at once. Some powerful upheaval had first split the sandstone and forced it upwards, causing a wedge-shaped cleft. This would be subsequently filled up with sand of a looser kind, washed down into it probably by the northern drift. The upheaving cause ceasing, by the cooling of the strata below, or some other cause, the two sides of the cleft would come together again, and the amount of the pressure they would exert would be something perfectly inconceivable; and if the effects that had been described could be produced by pressure, doubtless it would be sufficient to account for the vertical strata at this particular spot.

Professor ARCHER read the second of his series of papers on ECONOMIC ZOOLOGY,—

PRODUCTS OF THE QUADRUMANA.

Dr. INMAN, in allusion to a remark made by the author as to the similarity between the flesh of monkeys and that of human beings, referred to some inquiries which he had made of a patient in the Northern Hospital who had been amongst the cannibals, as to their ideas on the subject of eating human flesh. He was told that they were great connoisseurs in the article. They considered the flesh of a white man not quite so good as pork, but that of a black man much better. During the long period his informant was among them, he did not think the utmost extent of his influence would have been able to save a black man.

SIXTH ORDINARY MEETING.

ROYAL INSTITUTION, 12th December, 1859.

The Rev. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

Mr. MORTON, F.G.S., exhibited several specimens of siennite, hornestone, granite, and other materials, taken out of the boulder-clay, in the neighbourhood of Kirkdale. They belonged to the same formation as prevailed in the Alps and Snowdon, and had no doubt been deposited by icebergs formed from glaciers. Immense quantities of earth and stones were sometimes met with on icebergs.

Mr. DUCKWORTH, F.R.G.S., in handing a curious old volume to the chairman, said, knowing how very scarce Samaritan manuscripts were, not only in this but in every other country, he thought it would be interesting to the members of the society to see one which he had picked up at Nablous, the ancient Sychar, when he was in Palestine. He obtained it through Jacob-es-Shelaby, the Samaritan, who visited England four or five years ago, for the purpose of collecting money for his poor brethren, who still, as of old, worshipped and sacrificed on Mount Gerizim. On the authority of Mr. Clarke, to whom he showed the MS. lately at the British Museum, it was a portion of the Pentateuch, commencing with the 15th verse of the 10th chapter of Leviticus, and continued without break to the 48th verse of the 25th chapter; there it stopped short and jumped into the 10th verse of the 2nd chapter of Numbers. The last verse was the 5th of the 5th chapter. The age of the MS. was uncertain. Jacob informed him that it was 900 years old, but he had no means of proving the truth of the assertion.

The following Papers were then read:—

ADAPTABILITY TO ALTERED CIRCUMSTANCES AN ATTRIBUTE OF LIFE.

By THOMAS INMAN, Esq., M.D., Sen. V.P.

There are few things of greater interest to man than the phenomena of life. To know how we live, and the influences which modify our condition is a constant ambition, and as every addition to our knowledge tends to shew us more of the unlimited power of the Creator, and the powerlessness of man, the search after truth has in it more than a simple interest.

I propose on the present occasion to draw attention to one of the attributes of life which has hitherto been little considered, namely:—the power existing in many living creatures of adapting themselves to altered circumstances.

No Englishman can be ignorant how some of his countrymen go to reside for years in the frozen north, where for wintry weeks together one dark night shrouds the sun from their gaze; how others live in the burning climes of India, where the heat is at times so fierce that contact with metal is absolutely painful. Nor are there wanting those who make the pestilential climate of Sierra Leone their residence for a time; and others whose days are chiefly spent in tending the fever stricken patients of hospitals, or nursing the victims of small pox, and other contagious disorders.

Yet these individuals do not die. A tree so treated would, however, do so speedily. The flora of Iceland would perish in India, and the tea of China would wither in Scotland. Even some of the higher classes of animals would perish under the same circumstances. The monkey dies in arctic regions, and the European dog lives with difficulty in the torrid zone.

It is clear that there is in man a power of adapting himself to very varied conditions.

This is to some extent due to his foresight, to his care, and to the power he has over nature and the animal and vegetable world.

Does he winter in the regions of eternal ice? he takes with him coal and the means of kindling fire; he surrounds himself as far as possible with an artificial atmosphere; and when he leaves that for the open air, he clothes himself with the skins of animals, which he has prepared for his comfort.

Does he reside amidst fiery heat? he surrounds himself with cooling zephyrs, while the play of fountains, breezes forced through wet mats, and punkahs driven by the natives of the climate, tend to make the atmosphere bearable.

In these respects, neither animals nor plants resemble us. The starving monkey cannot light a fire, nor can a rose tree put on a great coat for winter. The sole provision nature has given to these is, that the tree sheds the leaves which the frost would kill, and exposes its trunk and branches alone to the cold; while the animal is simply provided with an extra growth of fur to meet the inclemency of the winter wind.

But there are circumstances in which man's foresight avails him little. When pestilence invades the land there is no escaping it by surrounding himself with a pure atmosphere. The poison, free as the air, is with him constantly—yet he does not succumb to its influence.

True it is, that even here science can to some extent control the march of death, and bridle seemingly the irresistible career of the invisible Azrael. But it could not do so unless the constitution of man was so framed, as to be able to tolerate the presence of noxious influences.

That man has this power few would deny, but there are not many who have an idea of its extent.

We have read of individuals exposing themselves to the

heat of a fiery furnace, remaining in it till beefsteaks were cooked at their sides, and coming out of the ordeal with scarcely a mark of anything unusual having occurred. And we have read of children who have existed for years in our own country, in a state of perfect nudity; and we believe the statements.

But if we were told that one man could take, with apparent benefit, a drug which would kill another, we should regard the thing as too absurd to be worth a thought. Yet it is indeed literally true, "that what is one man's meat is another man's poison," and that one individual can exist and be in health, in an atmosphere which would kill another. This immunity is brought about by a gradual change of circumstances, and we cannot demonstrate the importance of this consideration better than by quoting some experiments of Claude Bernard, which I have extracted from Lewes' "Physiology of Common Life."

"A sparrow," he says, "left in a bell glass to breathe over and over again the same air, will live in it for upwards of three hours, but at the close of the second hour, when there is consequently still sufficient air to permit this sparrow's breathing it for more than an hour longer; if a fresh and vigorous sparrow be introduced, it will expire almost immediately. The air which would suffice for the respiration of one sparrow suffocates another. Nay, more, if the sparrow be taken from the glass at the close of the third hour, when very feeble, it may be restored to activity, and no sooner has it recovered sufficient vigour to fly about again, than if once more introduced into the atmosphere from which it was taken it will perish immediately. Another experiment points to a similar result. A sparrow is confined in a bell glass, and at the end of about an hour and-a-half it is still active although obviously suffering, if at this time a second sparrow is introduced, in about ten minutes it will be found that the new

comer is dead, while the original occupant hops about cheerily and flies about the lecture room as soon as liberated."

After these experiments, Mr. Lewes makes some remarks upon the explanation of the phenomena, with which I do not agree, but which I will not stop to discuss, proceeding rather to some farther experiments illustrative of my meaning.

"One bird," he remarks, "will live in the bell glass for three hours, but two birds of the same species, age and size, will not live one hour-and-a-half, as might be supposed, but only one hour-and-a-quarter.—Conversely, the bird which will live only one hour in a pint of air, will live three hours in two pints."

We may next quote his account of two young Frenchwomen who were in a room heated by a coke stove. One of them was suffocated and fell senseless to the ground, the other, who was in bed suffering from typhoid fever, resisted the poisonous influence of the atmosphere, so as to be able to scream till assistance came. They were both rescued, but the healthy girl, who had succumbed to the noxious air, was found to have a paralysis of the left arm, which lasted more than six months.

From the first experiments, we learn that a bird has such a power of adaptability to altered circumstances, that by gradually being exposed to deterioration of the air it breathes, it can live in an atmosphere which would destroy another bird if suddenly exposed to it.

The last of his observations does not militate against this. The girl with typhoid fever has had her system slowly accustomed to the presence of an unusual quantity of carbonic acid in her blood from the rapid waste of tissue: she is much in the same position as the half-poisoned bird, and can bear a larger dose of the asphyxiating agent than the one who comes fresh to it.

With these experiments as a starting point, let us endeavour to find out other facts which bring us to a similar conclusion.

Continuing with the lower animals, we turn our eyes from the air to the water. There we find two distinct sets of creatures—the inhabitants of salt water and those of fresh. Experience tells us that if we place these suddenly into their opposite conditions they die immediately. Thus, Forbes in speaking of some star fish, says that the most effectual mode of killing marine animals, so as to preserve their appearance, is to dip them instantly into fresh water.

This seems to prove that salt water fish cannot live in fresh, yet daily experience disproves this. Who is not familiar with the fact that the salmon leaves its lakes and rivers, and takes itself to the sea, as if it were its native element, and after awhile returns, a bigger fish, up to its original haunts in the fresh water. In every tidal river, too, vast numbers of marine animals are exposed alternately to fresh and salt water.

Not only so, but we find occasionally in pools near the sea, a large number of shrimps and prawns, although the water is perfectly fresh. Thus, last summer I obtained an extensive haul of prawns from shallow pools on the north side of the Great Float—once Wallasey Pool—and I have yet the spectacle of the same species existing side by side in my fresh water and salt aquarium. It may fairly be assumed, that these pools were once saline, and that they have gradually become fresh by the soaking into the earth of the saline solution, and its gradual replacement by rain water.

To satisfy myself of the truth of this, I placed a minnow in salt water, and found that it died in ten minutes.

On mixing salt and fresh water in equal parts, I found that another minnow lived an hour. With two parts of fresh and one of salt, another minnow lived three hours. With three parts fresh to one of salt, another minnow lived for eight hours, and I then replaced it in my fresh water tank.

The converse of my experiments, *i.e.* the placing salt water

animals in fresh, was abortive, as the prawns escaped by leaping out of the basin during my absence.

I noticed that the minnows which I placed in the salt water, sank to the bottom of the fresh water tank when I replaced them in it to ascertain whether they would revive.

I do not know how far we may use the facts in illustration, but it is at least interesting to know that the fish and prawns in the Mammoth Cave, at Kentucky, which are found in pools not now connected with the interior river, have no eyes, and that horses sent down young to work in mines, soon have cataract: the creatures not wanting the eye for use it becomes useless. We are all of us familiar with the ease with which a dog or cat—both carnivorous animals—adapt themselves to a purely vegetable diet; and I remember reading of a colony of dogs in a certain island, where they had been left accidentally, by ships touching there for turtle, which had learned to subsist altogether upon turtles' eggs and salt water.

We may now proceed to man, and the last anecdote will help us to our first illustration. We ask if dogs can live on sea water for drink, why cannot man? The first answer I met with to this question was in one of the reports from an Australian surveying ship, the captain of H.M.S. "Beagle," stating that the natives of the country about the Gulf of Carpentaria, had learned to drink salt water almost habitually, in consequence of the great scarcity of fresh. And in a work on shipwrecks which I consulted for another purpose, I found that one narrator describes having drunk a hearty draught of sea water while suffering from the pangs of thirst, finding himself greatly refreshed thereby; though he was subsequently purged. It is commonly stated that salt water produces madness; but as this occurs quite independently of drinking this fluid, and is a common accompaniment of starvation, we may look upon the madness so often following draughts of sea water as a coincidence rather than as effect and cause.

Our next illustrations shall be from facts more or less familiar to all. We begin with the snuff taker: when he begins the habit, the effect of the pungent powder is disagreeable—it irritates and produces sneezing and a copious discharge of nasal mucus—yet, after a time, the nostril accustoms itself to the stimulus and it is absolutely painful to leave the habit off.

In the same way, workmen having much to do with chlorine suffer during the early days of their apprenticeship severely from cough and tightness of the chest; but after awhile they are so accustomed to the fumes, that they can breathe with impunity an atmosphere quite unbearable to a neophyte.

But this power of adaptability is most conspicuously shown in sea sickness. Man was not intended to live the life of a sea-bird, tossed up and down, now by the furious storm-wind, and now on the billow raised thereby. His habitation is on the earth—for that his frame is prepared. When he goes to sea he suffers for it, he cannot be shaken comfortably, and he becomes violently sick and otherwise unwell. Sometimes even he is sick unto death if the voyage is stormy and protracted. But as a general rule, the frame adapts itself to the altered circumstances, and after awhile the sailor goes about with as little discomfort on his rocking ship as a landsman feels in a railway train.

But all do not get this immunity from suffering to the same extent—can we account for this? The answer is readily given, for I find from the extensive experience of sea-going captains, that the duration and severity of the suffering is in proportion to the patient's debility; in other words the strong and healthy invariably adapt themselves to circumstances sooner than the delicate.

Hence we draw a corollary important to sufferers, and endorsed by very wide experience, viz:—That artificial stimulants which increase for a time the strength of the individual

will enable him to adapt himself, which he could not otherwise do. Brandy and water is the most popular and generally adopted stimulant, but the following occurrence will show that Champagne is of signal service. An officer going with his regiment from England to Canada, suffered so severely from sea-sicknes that it was feared he would not live to reach the land; one day, however, when he had been brought on deck to enjoy the air, a party of his comrades were sitting quaffing Champagne, and one of them commiserating his woe-be-gone looks, brought him a tumblerful with the hearty speech—"come, old fellow, drink this off, it will do you good!" The man obeyed, jumped up quite well, asked for more, tossed it off, ate heartily, and was not ill again.

This power of adaptability is farther shown in the experience of most of our tobacco smokers and chewers. When first the cigar is puffed, the neophite pays the penalty of his luxurious propensity, by suffering from nausea and sickness; and the first "chaw" excites an excessive secretion of saliva. After a few days, however, these effects cease, and the pipe and the quid become real luxuries and at length all but necessaries of life.

It is to be remarked, however, that if the health fail from any cause, the smoker will experience many bad effects from his cigar, and I have some personal friends who have abandoned what was once a luxury to them, because it made them ill. They have lost the power of adaptability they had once possessed.

In like manner it is to be noted that we soon become so familiar with various smells and sounds, that we are unable to recognize their presence. Thus, I knew an individual who told me that on his buying his third bottle of cod liver oil he was so convinced of its impurity that he resolved to change it. He declared that it had no smell whatever, but his wife who was not accustomed to take it, declared that the fishy scent

was strong. Another friend who took Harrogate water daily, experienced the same thing: in a week from the commencement of the course he became so utterly unconscious of the smell, that the water seemed nothing more than that of a very soft spring.

The druggist, tallow chandler, dissecting room porter, the gas maker, and others, whose business habitually brings them in contact with peculiar odours, soon become insensible to them, and cannot perceive them even if they try.

This is remarkably the case with certain odorous substances: a man after eating his dinner has his breath so tainted for some time, that a fasting friend will readily detect the dishes he fed upon, yet the scent becomes a nonentity to the latter as soon as he has dined too. Every one has heard of the complacent lady who only took onions when her husband did the same, lest his nose might be offended. Smokers are familiar with the fact that they become insensible to the smell of tobacco smoke in a room, as soon as they themselves adopt a cigar with the rest, and that they recover the power of smelling it again if they cease to "blow a cloud," while their companions persevere. I know at the present time a publican's widow who has been for twenty-years accustomed to the "Bar," and once was quite unconscious of the smell of the Spirits. Yet now that she is suffering from the early signs of consumption, her greatest misery is to be exposed to the smell of liquor.

Our books are rife with stories of individuals becoming so accustomed to sounds as to be unconscious of their presence. We hear of artillerymen sleeping profoundly during fierce bombardments, and close by the roaring guns. Of millers, who can only sleep quietly while the mill is going; of Londoners who are insensible to the ceaseless din of omnibus, cab and waggon.

Still farther we read of Indian servants who can work the

punkah during their sleep; and I know from personal experience that an individual may become so adapted to the rocking of children in the arms, to soothe them, that it may be done mechanically during sleep.

But of these instances of adaptability, many exist only during health—and during sickness the power is lost. When all is well, street noises are ignored by those accustomed to them, but when such an one is pulled down by sickness they become intolerable, and the street must be laid with materials to deaden sound.

The question now suggests itself, do those smells which are nauseous cease to affect the system when that has become accustomed to them, and they are no longer perceived as such?

We must answer the question shortly, as details would be repugnant, and simply say that the experience of nurses, surgeons, medical students, butchers, nightsoil men, and others, shows that though the smells they are exposed to may at first produce sickness, loss of appetite, and nausea, yet they ultimately cause no further mischief in those exposed to them. The last observation involves another question. Are bad smells, as such, prejudicial to health? This is a subject on which there is much prejudice. Instead of examining whether *they are*—we answer positively *they must be*, and think the problem satisfactorily solved. A recent investigation of this subject has led me to doubt whether bad smells are essentially deleterious.

To many individuals the smell from droves of pigs is excessively disgusting, to others the scent from a sheep-fold is equally nasty, yet neither pig drivers or shepherds are unhealthy. I am told that in hot countries where negro slaves are abundant that the effluvia from them has a most horrible smell, yet no unhealthy results follow its inhalation. Again, the London Journals have teemed during the past

summer with complaints of the sickening odour of the Thames, and for many weeks prophesies where uttered of the pestilence such a state of things would cause. Yet a careful enquiry shows that no epidemic, or illness can be traced to it, nor yet that those who are ill from other sources are unable to get well. The river police, the boatmen, the sailors on the steamboats, and those who dwell on the river banks have been quite as free from illness, as those living in other parts of London, or in other towns.

Then, again, we may point to the makers of fish manure, glue makers, nightsoil men, and all Mr. Rose's scavengers, to gas makers, bone boilers, to curriers and leather dressers, all are habitually inhaling nauseous smells, yet they are all as healthy as those who do not come in contact with anything unpleasant.

Even sulphuretted hydrogen the most disgusting of all gases, and positively a poison in a concentrated form, seems to be inocuous when largely diluted. To ascertain with certainty whether this was so, I wrote to a physician at Harrogate, under the impression that if the gas in question was really prejudicial, the nymphs who guard the odorous springs ought to be a delicate lot. His report was that the air in the vicinity of the springs was highly tainted with the gas, so as to be very disagreeable to strangers, yet those who lived in the atmosphere were, if anything, more rosy cheeked and healthier than their neighbours.

At the period of making this enquiry I was engaged to give evidence in a nuisance case, in which injury to health was supposed to have arisen from alkali waste, which smelt strongly of sulphuretted hydrogen. I visited the locality twice, but I found all those which I saw about the place, to be full as healthy as most villagers are, and had there not been another form of nuisance, respecting which there was no doubt, I fear, that though retained for the plaintiffs, my

evidence would have been in favor of the defendants. One form of this gas, namely sewer smell, has long been supposed to be the nastiest of all odours, and the most deadly; doubtless it is so in a concentrated form, yet rats live and thrive in it, and the men who get their living by raking amongst sewers, seeking stray coins, and unconsidered trifles, do not suffer from their employment.

We are not without evidence that nauseous smells are the reverse of being unhealthy. Thus, for example, few people in Liverpool are not familiar with the disgusting smell of raw hides, yet a merchant told me that on one occasion these seemed to be the means of guarding a part of a ship's crew from fever. Thus, the ship amongst other things had a lot of hides on board, these were close to one of the mens' sleeping cabins, and the air in them was constantly impregnated with their nauseous odour. Yellow fever broke out on board shortly after they left port, and all the crew were affected by it, except those who slept in the stinking cabins, they escaped to a man. The crews of guano ships occasionally suffer, I understand, from sore eyes, but otherwise they are healthy.

Conversely we may say, that such poisons as are known to be deleterious to the human frame have no smell recognisable by our senses. The plague poison is recognised by its effects, but the nose cannot smell it out; and yellow fever and ague poison are equally scentless.

The only question now to be noticed is—can the system adapt itself to these odourless poisons as it does to the foul smells of which we have spoken? And if so, under what circumstances? The answer is interesting to everyone, for there are few who are not exposed to these poisons at one time or other. That some are accustomed to inhale the ague poison with indifference is seen in the negroes of Africa and elsewhere, who breathe the air which kills their European visitors. Nurses long accustomed to the air of fever wards

respire without discomfort an atmosphere which once gave them fever, and which would give it them again were they like Claude Bernard's bird, to escape for a time into the fresh air of the country, and then to return to their old wards. In climates where miasms exist, but not largely, a mild fever is all the new comer suffers, and he then becomes acclimatised.

This adaptability in our own country is conspicuously shown during the occurrence of epidemics. When cholera, like an invisible cloud, envelopes a whole town, there is reason to believe that all inhale it equally; yet the mass escape. When typhus, scarlatina, or other diseases of similar origin are amongst us, we see the same thing; some fall ill and die, while the majority escape.

It may be answered to this that there is no proof that the poison is ever taken into the system of those who escape, and consequently that the foregoing facts are no proof of adaptability. One single circumstance, however, will show that our conclusions are correct. A pregnant woman is exposed to small pox, she does not herself take the disease, but the infant she carries does, and it may be born covered with pustules. In this case (and many such are recorded) it is impossible for the infection to reach the child except through the mother; but the latter is not affected with the disease because the system has adapted itself to the poison.

It being then established, that contagion may be coursing through our veins without it affecting us, we next endeavour to ascertain who those are which succomb to it; thence we can deduce the reason why others escape. We might turn to Eugene Sue as an authority on this question, for in the "Wandering Jew" we find the Jesuit understanding well how to bring the strong man into the clutches of the cholera; but we prefer taking a medical authority. Dr. Robert Williams, writing on the plague, remarks. "In selecting its victims, this poison follows the law of most other morbid poisons, attacking the poor

rather than the rich, women rather than men, patients labouring under disease rather than healthy individuals, persons constitutionally feeble rather than the robust, and also those addicted to intemperance or other excess than those who follow more strictly the precepts of Mohammed. Misery and poverty have been observed by all writers greatly to predispose to this disease."

Typhus, it is well known, follows in the wake of war and famine, and dysentery is most common where want and privation prevail. To illustrate this it is only necessary to point to the Crimean campaign ; during the first year the condition of the soldier was most deplorable, and half the troops were ill with fever and dysentery. But far from falling under the blow, England roused her energies to ward it off. Food of the best kind, comforts unlimited, and unremitting attention were freely lavished; they soon all but banished disease and death. But this illustration is incomplete because improved scavenging went hand in hand with improved diet; we must therefore seek another. We again turn to Dr. Williams and read his account of dysentery. In that we find, that in the West Indian islands the mortality from this disease was at one time ten times greater amongst the European soldiers than amongst their officers. This was, after much research, traced to the fact that the former lived chiefly on salted provisions, the latter upon fresh. Reason dictated an alteration ; it was made, and the result was a diminution of mortality of ninety per cent. Similar observations have been made at other unhealthy stations, and in our fleets as well as armies.

A thoroughly good diet will enable the system to adapt itself to a poison where a poor diet would not allow of the power being exercised. Nor is it without interest to know that tonic medicines, such as quinine, will enable the system to adapt itself to bear poisons which, without its use, would have fatal influence. Thus I have seen patients apparently

stricken down with typhus recover their usual health in twenty-four hours under the strengthening influence of large doses of quinine. The free use of the same drug will enable persons to live in marshy districts without contracting ague; and I have been told by Dr. Thomson, of Aigburth, and Dr. Clark, late of Cape Coast, that an abundant daily dose of quinine will give to the healthy white man an immunity from yellow fevers second only to that exhibited by the Negroes. When quinine loses its value the addition of steel to it seems to restore its power. It is not that the poison is destroyed in the system by the use of these drugs, for experience shows that such individuals often carry with them to Europe enough of the miasm to produce ague, when by any chance they are debilitated. The sole use of the drugs is to enable the constitution to adapt itself to the altered circumstances, and in this respect they may be compared to the champagne which cures sea sickness.

The whole tenour of these observations shows that the power of adaptability is proportionate to the vital power, and that the stronger the constitution the greater the immunity from external influences. Whenever, therefore, there is a necessity for adaptation, it is well to prepare for it by good living, rather than by starvation; and by a moderate use of wine, than by floods of cold water; and if a sea voyage is in prospect, beef steaks and porter are more likely to give immunity than soup mâigre and a crust of bread. The English are proverbially better sailors than their Gallic neighbours; and there is little doubt that they derive this peculiarity from their choice of solid foods and heavy drinks, in preference to unsubstantial dishes and light wine. Long may these tastes be retained!

ON THE PHYTOTYPE OR ARCHETYPE OF THE FLOWERING DIVISION OF THE VEGETABLE KINGDOM.*

By J. BIRKBECK NEVINS, M.D. Lond., F.B.S.E.

It is now about seventy years since the poet Goethe published a little work, entitled "The Metamorphosis of Plants," in which he laid down the principle that "every part of a flowering plant is a modification of a leaf," and illustrated his proposition by a variety of ingenious arguments, derived from the habits and growth of plants. This doctrine was rejected at first by nearly every naturalist of his day, and even within the last five-and-twenty years the theory was alluded to by teachers of botany, only to be ridiculed and put aside as the fancy of a poet, but unworthy of belief by a botanist. The general arguments by which he supported his opinion were such as the following:—

It is well known to gardeners that if a fruit tree is too much manured it runs into leaf, and produces little blossom or fruit; but if the same tree, which has thus become almost barren, is deprived of manure and the branches pruned, the leaves diminish in number and luxuriance, whilst blossoms take their place, and a copious supply of fruit is obtained. The same tree, therefore, can be made to produce leaves or flowers, according to the manner in which it is treated—that is to say, "starve a leaf and it becomes a flower."

Again: double flowers are generally barren. Why? Because the plant being carefully tended and manured, the

* The simple cell, variously multiplied and modified, has long been recognised as the type of the cellular, or non-flowering division of Plants. The object of this paper is to shew what is the typical form upon which the vascular, or flowering division of the vegetable world is constructed.

stamens and seed vessels become more luxuriant in growth and appearance, and are changed into petals or flowers. But if no care is bestowed upon the double flower it soon runs down and becomes a single one; the luxuriance and beauty of the flower are lost: but on the other hand it becomes fruitful, and bears seeds, of which before it was destitute. That is to say, "starve a double flower and the petals change into stamens and seed vessels." This conversion of petals into stamens is readily seen in the water lily, plate 1, fig. 1, *a b c d*, in which there is every gradation from a perfect petal, down through a half petal and half stamen, to a perfect stamen.

It is also seen in the double dahlia, which soon loses its perfection, and acquires an "eye;" that is, the brightly-coloured delicate petals become changed into dark green coarser leaves; and by a still further change, the green eye disappears and changes into the yellow one, which consists chiefly of stamens and seed vessels.

The appearances sometimes met with in flowers and fruit which are generally called "monstrosities," further illustrate this conversion of one organ into another. For example:—

The green calyx of the cowslip is converted into a yellow organ, not to be distinguished from an ordinary flower. In the auricula, some of the yellow stamens are frequently changed into purple petals, and the flower becomes partially double.

In pl. 1, fig. 2, *a b c*, the seed-vessel of the columbine is first shown in an almost natural condition, but open; there is then a disappearance of a few seeds, and small leaves tipped with imperfect seeds have taken their place; and in the last figure there is scarcely a seed present, though we can still see a few imperfect ones amongst the large leafy organs which have superseded them.

In the rose these monstrosities are not uncommon; and in pl. 1, fig. 3, *a b c*, the calyx is seen to be changed into petals,

whilst the stamens are absent, or reduced almost to nothing. From the centre of the flower, also, a branch proceeds, which in one case bears leaves, aud in the others a flower, whilst the seed-vessels are in the anomalous condition of half seed-vessels and half leaves.

In the double cherry the monstrous character of the fruit is the ordinary one; for instead of the flower ending in a cherry, it produces two distinct green leaves in its centre, and never bears any fruit at all.

In the pear, represented in pl. 1, fig. 4, the stalk which has borne the fruit has not terminated as is usually the case, but the core of the pear has grown on, and the result is a leafy branch.

In the Epacris, pl. 1, fig. 5, the seed-vessels have not been produced in the ordinary way, but they have grown into leaves, which project from the centre of some of the flowers, whilst others are in their natural condition.

The manner in which these phenomena are connected together, and the so called monstrosities proved to be in accordance with a natural law, is shown in pl. 2, figs. 7 and 8, in which the usual, or as it is called the *normal* arrangement of leaves is represented in the rose leaves (fig. 7), and the buds (fig. 8.) These organs are naturally arranged in a spiral direction, one above another, but sometimes the space between the leaves does not grow, and they become opposite, as in the pea (pl. 2, fig. 10.) Then the stem, or as it is often called by botanists, "the growing axis," begins again to grow, and after an interval another leaf appears; the stem ceases to grow, but puts out another leaf, and a second pair of opposite leaves is the result. And it may happen, as in the honeysuckle (pl. 2, fig. 11), that the bases of these opposite leaves unite together, as shown in the drawing.

In other instances, the stem ceases to grow between four or five leaves, instead of simply two, and then it is surrounded

by several leaves, as in pl. 2, fig. 9 ; and if the *bases* of the leaves in the honeysuckle unite, there seems no reason why the *sides* of other leaves may not unite also ; and then the stem would be surrounded by a cup-shaped organ, arising from the union of several leaves surrounding it. In short a kind of bell-shaped flower would thus be produced.

The same principle of the successive formation of several rows of organs, one above another, is illustrated in the drawing of the Magnolia (pl. 2, fig. 13), in which the lowest row is brightly coloured, and, although called a calyx, resembles the corolla in brilliancy and hue. The stem having grown, has produced another row of thicker organs above this, which is more distinctly seen in the sectional drawing (pl. 2, fig. 12.) This row is called the corolla, and the stem continuing to grow, has next produced row above row of smaller organs, called stamens; and now, in the ordinary course of things, it would grow a little longer, and terminate by the production of what is called the seed-vessel or fruit. But instead of this, it has continued to grow, and has produced still further, row above row, of what look like coloured leaves, or petals, or almost any name by which we may choose to designate them ; though they are proved eventually to be seed-vessels, by the changes consequent upon ripening. Having grown so far, there is no evident reason why the stem should not continue to grow still further ; nor is there any apparent reason why, having changed the nature of its productions so frequently, it should not change them again, and begin to produce leaves a second time. Such is, in fact, the ordinary course of things in the pine apple (pl. 1, fig. 6); in which, after producing fruit, the stem, or "growing axis," continues to grow, and does produce a crown of leaves. It generally happens that the vigour of a plant is exhausted by the production of the fruit, or the summer closes, and growth is suspended; but if the stem should be unusually vigorous, or the season uncommonly favourable, it may

happen that the production of the fruit does not put a stop to its growth, and there may then be a number of leaves, as in the case of the so called monstrous pear in pl. 1, fig. 4. Or there may be no fruit at all; but the stem, having produced the bell-shaped ring of organs or flower before mentioned, may continue to grow, and produce common leaves again, instead of giving origin to stamens and seed-vessels, as in the case of the Epacris (pl. 1, fig. 5.)

The common bond of union, then, amongst all these examples is, that the stem grows for a time, and after a time its further growth is arrested, and it puts out organs, which sometimes are ordinary *leaves*, either opposite to each other, or arranged in a circle or "whorl"; and at other times are more delicate and variously coloured, and are called *petals*. Then the stem resumes its growth, and produces another circle of leaves or petals, or of organs still more delicate and different in form and purpose, called *stamens*. Again it renews its growth, and either repeats the former productions, or gives rise to an organ or organs, called the *seed-vessels* or the *fruit*. Now, as the ripening of the fruit or seeds is an operation demanding great energy, the vigour of the stem is by this time generally exhausted, and its further growth ceases: but in some instances its powers continue unimpaired, and it always continues to grow and produce fresh leaves, as in the case of the pine apple; which we call, therefore, natural, because it is usually observed in this plant, whilst in other instances this continued growth is only occasional and exceptional, as in the case of the rose, the epacris, and the pear, and we call it monstrous, because it is unusual—although, in truth, they are both connected by the same law of vegetable growth, and merely differ in the circumstance that one is common, and the other uncommon.

Such then are the phenomena upon which Goethe based his announcement "that all parts of a plant are modifications of

a leaf;" and it is a careful consideration of them, free from prejudice against himself, (from the fact of his being known as a poet rather than as a botanist), which has gradually led to its universal acknowledgment by naturalists in the present day. But although admitted to be true in the main, it is always with some degree of reluctance; for it is said, with truth, "a flower is a flower, as much as a leaf is a leaf; and what right have we to call the flower a modified leaf, any more than the leaf a modified flower?" Nay, further, there are plants without leaves at all; which, although without them, are perfectly capable of growth and of reproduction, such as the Dodder (pl. 2, fig. 15*a*), and the Cactus, which are all *stem*, and the Rafflesia (pl. 2, fig. 14), which is all *flower*. It appears, therefore, that leaves are not necessary, and are not always present; but there are no instances of perfect reproductive plants destitute of flowers; and therefore it would seem more correct to take the essential organs as the basis, rather than unessential ones, and say that everything is a modification of a flower rather than of a leaf. But again, "what is a flower?" for there are multitudes of plants—for example, the arums, the firs, the willows, and the "everlastings"—which never have petals at all, and consist of stamens and seed-vessels only; either covered and protected by simple scales, as in the firs; or surrounded by organs of various character, but certainly not petals, as in the arums and the "everlastings." In the firs there are no leaves in any ordinary sense of the term, and therefore there is neither leaf nor flower for the other parts to be modelled upon.

It is impossible not to feel the force of these objections; and yet the more fully the general principle laid down by Goethe is thought upon by the botanist, the more is he impressed with its substantial truth, and the more clearly does it furnish the key to the varied phenomena of vegetable growth. I have, therefore, been induced to search for some

other type, which should be free from the objections so naturally felt to that selected by Goethe, whilst it should still retain the essential truth which he taught. With this object in view it appeared to me that the internal organisation of the plant might be likely to furnish a more simple and unexceptionable type than an organ like a leaf, characterised chiefly by its external form, and other non-essential features. For the mention of a leaf raises at once the notion of an organ of a more or less expanded and flattened figure, of a green colour, with more or less rigidity of structure, and furnished with a longer or shorter stalk, by which it is attached to the stem; all of which characters are unessential, and are often absent in greater or less degree, though all associated together in the general notion of a leaf. It also appeared probable, that the true type of the plant must be sought for in the simplest perfect organ, rather than in one so complicated in its structure as a leaf is in its ordinary acceptation. The progress of investigation, both in animal and vegetable physiology, has also taught us that the earliest and most rudimentary stages of growth are frequently the most instructive, and I therefore resorted to the embryo of various seeds, in hopes of finding the desired type there, but without success. Neither the radicle nor plumule, nor the cotyledons when they were separable, in the pea, the bean, the apple, the grape, the acorn, the almond, the castor oil, the nux vomica, the mustard, the nut, nor the wheat, shewed anything but simple cells, and it was therefore necessary to look elsewhere for the type of the flowering plant, as distinguished from the flowerless division of the vegetable kingdom.

In searching for the simplest form of perfect organ in the fully grown plant, what are called the abortive stamens of the stork's bill, the Erodium (fig. 16 *a*), furnished the most satisfactory result; for they are so delicate as to become trans-

parent by gentle pressure between two pieces of glass, and when placed under the microscope their entire structure was seen to consist of a *single unbranching spiral vessel, surrounded by delicate* spindle shaped *cells.* (Pl. 3, fig. 16 *b*).

Here, then, was a very simple form of structure, which constituted the whole of a distinct organ in a highly organised and perfect flowering plant; and it seemed probable that this might furnish the desired type, for it readily admitted of extensive modifications, whilst still retaining all its essential simplicity. Thus in the case under review the organ was a simple, delicate, slender, elongated structure, and the spiral was single, and the cells delicate and tapering; whilst it was evident that in a more complicated organ the spiral might be multiplied and branching, and the cells increased in number and thickness, without losing their essential character of a *spiral vessel surrounded by cells.* If, however, this was the true typical model upon which the flowering plants are constructed, it ought to be found in all their various parts, and I therefore turned to the corolla in search of it there. In looking for a corolla which should readily admit of microscopic examination, the lily-of-the-valley, (fig. 17 *a*) was selected. This belongs to the endogens, which are characterised by the singular regularity with which their various parts are constructed in multiples of three; and it was therefore probable, that if the above type was the true one it would be met with in this flower, repeated either three times, or six or nine times, &c. On examination there proved to be six parallel spiral vessels, connected by cells so delicate that they have not been represented in the drawing, pl. 3, fig. 17 *b*.

The united stamens of the leguminosæ (pl. 3, fig. 18 *a*) were next examined; and in the tube formed by the base of the nine stamens there were nine parallel spirals, also connected by very delicate cells, as shewn in fig. 18 *b*. The next example illustrated the same typical form in a very interesting manner.

It consists of the seed-vessel of the wild hyacinth (pl. 3, fig. 19 *a*), which like the lily-of-the-valley is an endogen, and in which, therefore, the three-fold arrangements of parts would be looked for by the botanist. The seed-vessel, however, is single (fig. 19 *b*); but although this is the case, it still shows the ternary structure by being triangular externally, and containing three cells internally. The summit of the style again is divided into three segments, but the style itself is single. On putting it, however, under the microscope, the three spiral vessels are readily visible (fig. 19. *d*), connected by slender cells; showing that the style, however simple in appearance, contains the typical form three times repeated; and its essential three-fold structure is ultimately shewn beyond the possibility of doubt, by its separation into three portions as the seed-vessel ripens, which are shewn in the drawing, fig. 19 *c*.

The parts hitherto examined had all been taken from the flower alone, and I therefore turned next to the stem and submitted the dodder, pl. 2, fig. 15 *a*, to microscopic examination. This plant consists entirely of a stem many feet long, without roots and without leaves; and it is so slender as to become transparent when subjected to pressure as previously described; and on examination it proved to consist entirely of several parallel spiral vessels, surrounded by delicate rectangular cells, fig. 15 *b*; the outer row of which was coloured by the red pigment of the plant. Here then the entire plant consists of the simple type previously found in the separate organs only.

The dodder being without leaves is, however, in one sense, an imperfect representation of the flowering plants; and I was therefore anxious to find one which should not be open to objection, and the delicate little Callitriche, pl. 3, fig. 21 *a*, so common in our ditches, furnishes both stem, leaves, and flower—all, in short, that is requisite for a perfect plant;

and the drawing, fig. 21 *b*, shews that the stem consists entirely of the simple type already obtained, and the leaves exhibited the branching spiral shewn in pl. 3, figs. 22 *b*, and 29 *m*, and pl. 4, fig. 31 *h*, only more deeply coloured by the opaque green pigment found in the cells of most leaves.

This typical form having now been observed in every part of the plant, the stem, the leaves, corolla, stamens, and seed vessel, I have ventured to give it the name *Phytotype*, or "plant type" (φῦτον a plant), by which we obtain a convenient designation for it, and avoid the objection of using a term which has already a well understood signification, such as "leaf or flower," to indicate a structure, which is in reality neither leaf nor flower, but the common basis of both.

The typical form being thus discovered in every part of the mature plant, it next became a question of interest to ascertain when it first makes its appearance; for the plant springs from the ripened seed, and the ripe seed takes its origin from the influence of the pollen upon the ovules contained in the seed vessel. But the pollen consists entirely of cells, without any spiral vessel, and the ovules are at first entirely cellular, and without any trace of vascular tissue. I therefore instituted a series of experiments on germinating seeds, which embraced the

Leguminosæ	Pea. Bean.
Cruciferæ	Mustard. Cress.
Rosaceæ	Potentilla. Geum.
Urticaceæ	Dorstenia contrayerva.
Cucurbitaceæ	Mellon.
Rutaceæ	Lemnanthus.
Ericaceæ	Rhododrendron.
Scrophularineæ	Digitalis.

Onagraceæ	Godetia.
Labiatæ	Lamium.
Polemoniaceæ	Leptisiphora.
Valerianaceæ	Valerianilla.
Caryophyllaceæ	Dianthus.
Resedaceæ	Reseda odorata.
Cupuliferæ	Acorn.
Gramineæ	Wheat and Oats.

Embracing altogether twenty different kinds of seeds, and representing sixteen natural orders, separated one from another by very wide and important botanical differences. The general result of these experiments was so similiar that I shall not describe them all, but confine myself to a few cases more minutely watched and carefully recorded.

1ST—THE OAT SERIES, PLATES 3 AND 4, FIGS. 23, 24, 25.

Fig. 23 *a*, pl. 3, represents an oat grain, so far sprouted as to have a radicle about one quarter of an inch long—on separating the integuments of the seed, the embryo *b* was easily removed—and on being placed under the microscope the plumule *c* was so delicate that it separated into a cluster of detached cells, in which no spiral could be detected, whilst the radicle *d* exhibited three or four parallel spiral vessels, surrounded by cells so loosely aggregated at the growing end, as to separate also into the curved cells shewn in the drawing.

At this very early stage of development then, there were spirals surrounded by cells in the radicle, but no appearance, as yet, of a spiral in the plumule.

In another grain, fig. 25, pl. 4, so far germinated as to exhibit a very small, scarcely perceptible plumule, and a branching radicle, the same appearances present themselves, viz.:—spiral vessels surrounded by cells in the radicle, but is yet no spiral in the plumule.

When, however, the grain had germinated so far as to appear above ground, fig. 24 *a*, pl. 3, and to possess a plumule tipped with a pale green colour, the spiral is well developed (*b*), and both plumule and radicle now exhibit the typical form of the "spiral vessel surrounded by cells," which constitute the entire oat plant, at this stage of its growth. The drawing, fig. 24 *b*, illustrates incidently an interesting feature, which was not unfrequently observed, viz. :—the greater size and distinctness of the spiral in the bright green portion of the blade freely exposed to the light, compared with the colourless portion near the soil or below it, which receives so much less of the invigorating influence of the sun's luminous rays.

2ND.—THE WHEAT SERIES, PLATE 4, FIGS. 26, 27, 28.

In germinating wheat the same phenomena were observed, though with some slight variation in the very early stage. In fig. 26 *a*, both plumule and radicle are visible, although both were still beneath the surface of the ground, and it will be observed that the typical spiral and cells are present in the plumule *b*, whilst in the radicle *c* the spiral is not yet developed. There were several long parallel vessels surrounded by very loose straight cells, which separated under the pressure of the glass, as shown in the drawing, but no spiral fibre could be detected at this time in the elongated tubes, although they were present both in plumule and radicle, in a grain rather further grown, as shewn at fig. 27 *b*, and in fig. 28 *b*, *c*, the progress of development is still further shewn. In this plumule the microscope shewed a central delicate green leaf, surrounded by a colourless sheath, and whilst the spirals were clustered together in fig. 27 *b*, they were here separated (fig. 28 *b*) into a single central spiral in the green leaf, and two which run parallel to each other in the sheath. The branching radicle (fig. 28 *c*) shews the spirals in

each division, but the cells have not been drawn, in order to avoid complication.

3RD.—THE BEAN SERIES, PLATE 4, FIG. 29.

This series illustrates several points in the development of a germinating dicolyledonous seed which were not observed in the monocotyledonous grains previously described. Figs. *a b* and *c* were all still below ground, whilst *h* and *l* were above the surface. In fig. *a* the radicle had barely protruded, and when the embryo was removed, and rendered transparent by pressure, the plumule exhibited merely cells, and even the radicle could not be said to possess spiral vessels, as it was impossible to trace any continuity in the spiral, which presented merely the appearance of isolated dots arranged so as to look like dotted ducts, rather than spiral vessels. In fig. *b* the embryo was so far developed that the plumule, although still within the seed, possessed the form shewn in *e*, and in this case the spirals were present in the radicle, as already observed in the wheat and oats, and they terminated abruptly at its junction with the plumule, which consisted simply of cells. In another case, shewn in *f*, the plumule was also still within the seed, but was a little further developed, and a single spiral vessel could now be observed in the central lobe of the plumule.

In *c*, the plumule had escaped from the seed, although still beneath the ground; and now the spiral could be traced in *g*, in each of the three divisions of the leaf.

The spirals in the radicles were so uniformly present in this stage and the subsequent ones, that they will not be further dwelt upon.

In *h*, the plumule, still a very pale green, was a little above the ground; and a very slight appearance of ramification in the spiral weight can be traced, as in *k*; whilst in *l*, which was a deep green, and about twice the height of *g*, the spiral was ramified in every direction, as shewn in *m*, pl. 4, fig. 29.

In this series then, the same general facts were observed respecting the assumed typical form, viz.:—that a spiral vessel or vessels surrounded by cells, constituted the whole of the germinating embryo—that the spirals appeared first in the radicles and that, as the plumule advanced in growth, they presented themselves first as a single spiral, then as a multiplied but unbranched one, and lastly as a spiral ramifying in every direction, and surrounded by cells of varying colours and character, according to the stage of progress of the leaf developed from the plumule. In the Lepidium (cress) pl. 4, fig. 31, the mustard, fig. 32, and the Leptisiphora, fig. 33, the same general facts were noticed. In pl. 4, fig. 31 *a*, the plumule was still below the ground, and very slightly developed, and no spiral could be traced in it, though it was present in the radicle *d*. In *b*, the cotyledons had appeared above ground, but were still very pale green, and there was now a single unbranched spiral in each lobe *e*, whilst in *c*, which was well grown and a deep green, the spiral was abundantly ramified as shewn in *h*.

In the Leptisiphora, pl. 4, fig. 33, it is needless to mention anything but the scattered cells, which are shewn in the drawing, which were separated by the pressure of the microscopic glasses.

In the mustard, pl. 4, fig. 32, it is extremely difficult to trace the spiral; for it is so obscured by the deep opaque green pigment in the connecting and covering cells of this thick hard leaf, that it is only here and there the spiral can be noticed, in the unconnected manner shewn in the drawing. The next subject for examination, pl. 4, fig. 34, the Dorstenia contrayerva was selected in order to observe whether there was any difference of importance between the temporary or cotyledonary leaves *a* and the permanent ones *b b*; but it will be noticed that there is no essential distinction between them, and the only further point to be dwelt upon in this drawing is—that the ramifica-

tions of the spiral vessels do not terminate abruptly, but they anastomose by looped junctions with others—a fact which is equally to be noticed in all other leaves, whether cotyledonary or permanent.

The last illustration in this series is taken from the acorn, pl. 4, fig. 30, which furnishes a striking difference to all the other seeds examined, arising from the hard woody character of the embryo *c*, even in its earliest stage. Both plumule and radicle are so thick and hard as to require careful slicing by a sharp tool before a section can be obtained thin enough to be rendered transparent; and even when such a section has been obtained, the continuity of the spiral is constantly interrupted *d*, by its being hidden by the dense elongated woody cells which compose nearly the whole of the embryo; or by the thick opaque masses of deep brown pigment, which colour the embryo even at a very early stage of its growth.

Since, however, the germination of seeds is not the only mode by which plants are propagated, I next turned for illustrations to those leaves which possess the power of originating buds from their surface when separated from the parent plant, like the Bryophyllum; and the appearances observed in the Gesneria and Sedum are shewn in pl. 3, figs. 20 and 22. The new plant in the Gesneria, fig. 20, is seen to be still attached to the decayed portion of the leaf from which it has sprung, fig. 20 *a*, and the Sedum is growing from the end of a still vigorous leaf, pl. 2, fig. 22 *m*. Both the plants are already furnished with leaves and roots, and are perfectly capable of an independent existence. They are, in fact, perfect, independent plants. On examination, the stem of the Gesneria, pl. 3, fig. 20 *b*, was readily seen to consist of the old typical form, the "spiral surrounded by cells;" but the leaf, *c*, was so thick as not to admit of satisfactory examination until it was split so as to reduce its thickness, when it also was found to present the appearances so often noticed before, of the ramifying spiral covered with thick green cells.

In the Sedum, pl. 3, fig. 22 *b*, the examination was very easy, for the plant was so succulent as to become transparent at once, and to present the structure both in its leaves and roots which is shewn in the drawing. I examined also a young shoot from a Euphorbia, but have not drawn it, as it corresponded entirely with those here represented.

From all these observations then, I think we are justified in concluding, that the *Archetype or Phytotype of a flowering plant consists of a spiral vessel surrounded by cells*—the *spiral* being *simple* or *multiplied* and *branching ;* and the cells being of various forms and strength, according to the purpose they have to serve.

Thus in the soft, rounded, and succulent leaf of the sedum the cells are circular and delicate in structure, and surround a slightly ramified spiral vessel; whilst in the germinating acorn the cells are dense and elongated, hard and woody, and already shew that the insignificant plumule and radicle are eventually to become British oak. In the delicate tapering staminoid organ in the stork's bill, the spiral is single and unbranched, and the cells are also tapering and slender; whilst in the various leaves which have passed under examination the spiral has been simple or branched, and the cells delicate or strong, according to the stage of growth and the habits of the plant. But in all these parts, as well as in the stem of the dodder, and the delicate organs of a flower, we find the same essential character, viz., "*the spiral vessel surrounded by cells.*"

Columbus shewed how to make his egg stand upright, and having done so, foretold that all who saw him would then make theirs stand much more perfectly than his. I have felt most strongly throughout these experiments, how entirely they stand towards Goethe's original discovery, in the position of Columbus' followers towards him. The observations just related have but shewn what Goethe himself would have taught

had he been possessed of such aids to observation as we enjoy in the present day. He saw distinctly that all the varied forms of vegetable life were constructed upon a clear and intelligent plan, and were not produced at random, or by unconnected acts of the Great Artificer of creation; and if he fell something short of the knowledge which we now possess, he still cleared the path for us to walk in; and botanists to all succeeding time will stand indebted to him for a law which was immensely in advance of his age, and is scarcely even now out of date—and none will be so desirous of acknowledging their obligation to him as those who have found in him a trustworthy and valuable guide through the intricacies of the vegetable kingdom. And in saying this I cannot refrain from alluding also to a remark of Linnæus, which, though not worked out by him so as to produce the results derived from Goethe's more elaborate research, is yet stamped by the comprehensiveness and simplicity of his genius, and contains even a deeper perception of the truth than the law announced by Goethe himself.

"Principium florum et foliorum idem est,"—"the beginning of flowers and leaves is the same,"—is the simple statement of Linnæus; a statement which he left as a legacy for succeeding botanists to work out, and which, although unremembered by me until after the completion of my experiments, is identical, so far as it goes, with the principle I have endeavoured to bring forward in the foregoing account. *My task has been to discover what that "beginning" is; and, having discovered it, to give it some simple and expressive name; conveying, if possible, the truth contained in Goethe's law, but free from the objections inseparable from his theory, in the form in which he expressed it.*

A dwarf on the shoulders of a giant may see further than his bearer; nevertheless he is but a dwarf, and the other is a giant still.

SEVENTH ORDINARY MEETING.

ROYAL INSTITUTION, 9th January, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The resignations of Dr. Marshall and Mr. Lidderdale, as Ordinary Members, were accepted.

Mr. MOORE exhibited a stuffed specimen of the white thighed colobus, (*Colobus leucomeros,*) one of the West African monkeys, with long silky black hair, the skins of which have lately been so generally used for ladies' muffs. He also submitted a specimen of the *Malapterurus Beninensis*, first made known by Mr. Andrew Murray, of Edinburgh, in 1855. It was a fresh-water fish inhabiting the Old Calabar river, ten inches long, and furnished with six barbels indicating its habits as a ground fish. Like other electric fishes, it was destitute of scales.

Dr. COLLINGWOOD said that the terms Catarrhine and Platyrrhine as proposed by Geoffroy St. Hilaire for the monkies of the old and new world respectively, were by no means of universal application. He had been led from an examination of the Quadrumana in the British and several Continental Museums, to the conclusion that the usually received definition of these terms was liable to numerous exceptions, one of the most remarkable of which was the colobus now before the society. The direction of the lower angles of the nostrils was the only constant character, for on being bisected, they converged towards the mouth in the old world monkies, and diverged in those of the new world.

Dr. THOMSON drew attention to several points of interest. One was the discovery of a new planet by Dr. Lescarbault, confirmed by M. Le Verrier, and endorsed by Mr. Lassell.

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There was a much higher value attached to this discovery than if it had been that of one of the numerous planets revolving between Mars and Jupiter, and now numbering at least fifty-seven ; it was seen making a transit of the sun, and consequently revolved between the earth and the central luminary—within the orbit of Mercury. M. Le Verrier had drawn attention to the probable existence of such a planet, or of a zone of asteroids near the planet Mercury, from certain disturbances in Mercury's course. Hence, by reasoning similar to that which had led to the discovery of Neptune, was M. Le Verrier induced to predict the discovery of the inner planet, Vulcan.

Another, was the probable influence of large boulders upon the banks of Newfoundland, carried there by icebergs. Such might be one of the causes of the origin of these banks, and their continuance. The St. Lawrence brought down the detritus ; the Gulf Stream carried it on till it met the Arctic current, and there it fell: the Arctic current brought down the ice, which the warm current from the south-west melted ; and the immense rocks transported by the ice would there be deposited. About the centre of the Great Bank, the Virgin Rocks were laid down upon the charts—rocks which could be crossed in smooth water; and near to them was a suspicious sounding marked 3½ fathoms—a spot which he had recently passed over, or very nearly approached. The whole of the soundings thereabouts seemed to require a fresh survey.

The third point was the deviation of the compass in iron ships, and the influence of the heeling of the vessel upon the magnets. From observation, he was led to believe that the deviation increased to a maximum when the course was at right angles to the line on which the ship was built: and this opinion was, he believed, entertained by one of the highest authorities in this country.

The following Paper (abridged) was then read —

ON THE RELATIVE CHARACTERISTICS OF WIT, HUMOUR, POETRY AND GENIUS.

By the Rev. JOHN ROBBERDS, B.A.

The above qualities may be called the *bloom* of the mind, without which human life would be somewhat dull. Just as it might be said that the indispensable ends of nature might have been effected without anything to afford pleasure to the senses, so it might be said that a man might discharge all the duties of life—do his work, maintain his household, love his kindred, and worship his God—without the above qualities; though love and worship would lose much of their true essence and power, were there not something in the man's heart akin to *poetry* and *genius;* but, independently of that, all the four qualities may supply a very precious zest and relish, as it were, to the plain, homely food of this working-day world, imparting innocent brightness and relief to refresh and cheer the heart in many seasons and occupations, which would otherwise be wearisome and dreary. "Genuine and innocent wit," says Sydney Smith, "is surely the *flavour* of the mind! Man could direct his ways by plain reason, and support his life by tasteless food; but God has given us wit, and flavour, and brightness, and laughter, and perfumes [he might have added, "and poetry and music"] to enliven the days of man's pilgrimage, and to charm his pained steps over the burning marle."

The above qualities (like our bodily senses) are more easily felt than described, and it would be as impossible to convey any idea of them by description to any persons who were not capable of intuitively feeling them, as to enable a blind man to appreciate colours, or a man devoid of the sense of taste, or smell, or hearing, to comprehend the enjoyment of delicious food, or fragrance, or music. And any attempt to construct

a specimen of wit, or humour, or poetry, by mere blind, rigid, mechanical adherence to the most scientific definition, would fail as egregiously as Madame de Staël's German baron, who was found jumping heavily over chairs and tables, saying, in explanation, "*J'apprends d'etre vif.*" Nevertheless, it may be interesting to attempt to analyse, define, and illustrate them.

The old sense of *wit* is something like the French *esprit* —quick and strong intellect—and by our old divines the word is used in this sense in the most grave and serious passages. But in the more special sense in which we now understand the word, how may we define it? Addison was, I believe, the first to point out that *wit* is the sudden perception of unexpected congruity or fitness in the midst of incongruity or unfitness, so as to produce an electric flash, as it were, of delighted and amused *surprise*. When a relation or resemblance is ingeniously made out between objects or ideas which are really utterly unconnected or dissimilar, the effect upon the mind is that of what we mean by wit. Many riddles or conundrums might be adduced as illustrations; but the finding of them out does not usually produce to its full extent the peculiar pleasure of a witty saying, because the very fact of setting the puzzle warns us that there is an ingenious solution, and produces, consequently, an impression of premeditation, which interferes with the perfect *surprise* essential to the pleasure afforded by true wit. The discovered answer to a riddle or conundrum has a similar effect upon the mind to that produced upon the mind of a child who succeeds in fitting a particular piece into a particular cavity of a dissecting map, by which Sydney Smith endeavours to illustrate the impression of wit. For the same reason jest-books, or collections of specimens of wit, are apt to be rather wearisome reading, because we *expect* to be amused, and therefore are not easily satisfied, and still less easily surprised. Wit, to be

thoroughly relished, whether in reading or in conversation, must come when we are not prepared to expect it. The examples that occur most readily come from the Emerald Isle, where wit, and humour too, have an indigenous growth. Miss Edgeworth tells us of a poor Irishwoman who thus accosted a gentleman and his wife. "Och! plase yer honour, I dreamt last night that your honour gave me a pound of tobacco, and her ladyship a pound of *tay.*" "Well, but don't you know, my good woman," said the gentleman, "that dreams always go by contraries." "Och! sure, then it'll be her *ladyship* that'll give me the tobacco, and your *honour* that'll give me the *tay.*" This is a simple specimen of genuine wit. The gentleman of course meant that if dreams went by contraries, the poor woman would have *nothing* given to her, but she adroitly and promptly showed that this condition of going by contraries could equally be fulfilled by inverting the order of the two gifts, thus revealing an unexpected congruity or fitness between two apparently incongruous things.

If I may venture to refer to a much higher source in illustration of this subject, it has always struck me that there was genuine wit in that humble and beautiful answer of the woman of Canaan who was imploring the Saviour's healing power for her afflicted daughter, and was told that the Son of Man was sent only to the lost sheep of the house of Israel, and that it was not meet to take the children's bread, and cast it unto dogs. "Truth, Lord," she replied, "but even the dogs eat of the crumbs that fall from the children's table."

This example may remind us that genuine wit is not necessarily frivolous. When the analogy which it unexpectedly detects is beautiful and true, it approaches the confines of poetry, as I shall presently have occasion to show. The wit of the Irish, for example, escapes from them on occasions of the deepest feeling. I remember hearing Mr. Samuel Lover

describe the funeral of a favourite actor at Dublin, who was much beloved by all the people about the theatre. Just as the coffin was being lowered into the grave, a poor old woman who had been in the habit of selling playbills at the theatre doors, said, while the tears were rolling down her cheeks, "Poor fellow! he's got his *pit-ticket* at last!" In another instance that occurs to me, Irish wit served to convey a very significant rebuke. Some one was in a furious passion at finding a heap of rubbish unremoved in front of his own door, and told an Irish labourer, with an oath, to take it away. "Where will I take it to, your honour?" said the man. "Take it to hell, so that you take it out of my way." "May be, if I took it to *heaven*, it would be more out of your honour's way."

One form of satirical wit is *irony*, or pretended gravity, in which an argument is conducted with minute elaboration and seemingly in perfect good faith, on the assumption of some false principle, of course with the view of placing its unsoundness in a ludicrous light. The great modern master of this species of wit is Swift. The calm irony of one of his essays of this kind may in some measure be seen in its *title*. It is called—"An Argument to prove that the Abolishing of Christianity in England may, as things now stand, be attended with some inconveniences, and perhaps not produce those many good effects proposed thereby." The satire is levelled partly at the so-called philosophical writers, and partly at the social vices and hypocrisy of his time. Another of his essays is an elaborate scheme for relieving the community from the burden of supporting the children of the poor by fattening them up as delicacies for the tables of the rich. The various economical advantages of the plan, and the different modes of cooking suggested, are detailed with calm minuteness and the most stolid gravity, and an apparently utter unconsciousness of any possible objection on the score of inhumanity or want

of christian sympathy; forming a keen satire on the heartless and unfeeling spirit which, no doubt, pervaded much of the legislation and "social science" of his day.

An analogous form of wit is what is called *parody*, or extravagant and ludicrous imitation of anything approaching to pomposity, or bombast, or false sentiment. George Canning excelled in this species of wit, as may be seen in his parodies of Southey's republican poems, and German Tragedy, in the "Poetry of the Anti-Jacobin." The "Rejected Addresses," by the brothers Smith, caricaturing the styles of the various poets of that day, are another well-known instance; and there have been many excellent examples in *Punch*.

A very common and easy form of wit consists in *punning*, or the mere play upon words, which is apt, however, to degenerate into miserable and weary trifling, and a systematic and determined punster is justly scouted as a bore. When not studiously sought after, however, a good pun is sometimes very amusing. This kind of wit is sometimes exercised at the expense of a person's name. Mr. Missing, a barrister on the Western Circuit, was once conducting the case for the prosecution against a man for stealing a donkey. The evidence showed that the donkey had disappeared, but failed to establish the theft; whereupon the judge interposed with the remark that he had not proved that the ass was stolen. "No, my Lord," said the counsel for the defence, "he has only proved that the *ass* was *missing*." The story adds that Mr. Missing felt so much aggrieved that the judge had to use his influence to prevent a hostile encounter between the "learned friends."

I suppose the best and most inexhaustible punster that the world ever saw, was the late Thomas Hood; but his peculiar power does not depend merely upon the wit of his puns; there is an under-current of grim, quaint *humour*, which makes him belong also to the next division of my subject.*

* An illustration was here given from Hood's "Faithless Sally Brown," an old ballad.

Wit, in the form of refined satire, generally abounds in the literature of the most highly intellectual and polished nations. Satire essentially consists in exhibiting a most absurd and contemptible image, which yet bears an unquestionable resemblance or analogy to the character or institution which it is sought to ridicule. The fables of Æsop, the comedies of Aristophanes, and the dialogues of Socrates among the Greeks; the satires of Horace and Juvenal among the Romans; the comedies of Molière, the novel of Gil Blas by Lesage, and the writings of Voltaire among the French; Butler's Hudibras, and the writings of Fielding, Dean Swift, and Charles Lamb, in our own literature, to which I may add the drawings of Hogarth; are among the most eminent examples. The ludicrous light in which Swift places various points of human nature and national boasting, by exhibiting the same qualities in Gulliver among the Brobdignags, or as observed by him among the Lilliputians and Laputans, set off as it is by the air of gravity and circumstantial reality imparted to the whole by his wonderful power of imagination, is one of the most remarkable instances of satirical wit that I know. In our own day we have witnessed most abundant outpourings of wit from the pencil of George Cruikshank, and from both pen and pencil in Thomas Hood, Thackeray, and the inexhaustible pages of Punch.

In taking leave of wit, I will just remark that it is a gift which is capable of being abused. Wit may be combined with a cold heart and a shameless spirit. It is proverbially said, that "ridicule is the test of truth," and there is no doubt that truth is the only thing that can outlive ridicule; but it is very possible for truth, virtue, honour, and every good principle and pure affection, to be, for a time at least, blighted by the cutting breath of corrupt and reckless wit. There is something very chilling and dreary, as well as coarse and offensive, in much of the wit of Voltaire and the French

writers of his day, and of all writers who seek by ridicule, however clever and brilliant, to crush and wither the pure impulses of nature, and the holy aspirations of the heart.

Let me now try to discriminate between *wit* and *humour*. I have defined *wit* to be the discovery of an unexpected congruity or fitness between things apparently incongruous. I think we shall find that *humour* is very often just the contrary, viz., the discovery of an unexpected *in*congruity between things that are, or are meant to be, harmonious and accordant. Humour is the quality on which the perception of the *ludicrous* depends. Wit, as I have said, is not always necessarily ludicrous: a stroke of wit may excite a species of admiration almost akin to that excited by an apt poetical image. But humour essentially consists in the sudden conjunction of two opposite states of *feeling*, like the flash arising from the union of two opposite electricities. Hence, humour implies a power of deeply appreciating the serious and tragic elements of life, in order to be proportionally struck with the oddity of the unexpected contrast with something utterly incongruous. As Hazlitt well says, "to understand or define the ludicrous, we must first know what the serious is." Thus, genuine humour can never be unfeeling, as wit can. The greatest humourists, such as Fielding, Swift, Thomas Hood, Liston, Charles Lamb, Carlyle, and Thackeray, have been men whose souls contained profound depths of melancholy and tender sorrow. Humour is accordingly developed, not so generally in speech as in the quick observation of what strikes the sense of the ludicrous in the speech or action of others. There is much exquisite humour in "Don Quixote," from the frequent incongruities between the solemn romance of the Knight and the homely common sense of Sancho Panza, his squire. There is a good stroke of humour in one of Addison's plays, where an undertaker is scolding one of his mutes for laughing at a funeral. "You rascal, you! I have

been raising your wages for these two years past upon condition that you should appear more sorrowful; and the higher wages you receive, the happier you look!" This reminds me of a story I lately read of a poor man, who was so wretched and cadaverous-looking that he at once gained employment at a London theatre to act the *Apothecary* in "Romeo and Juliet," but became so fat and jolly upon his pay that he lost his situation, until a return of distressed circumstances rendered him again fit for the part. No modern writer excels Sydney Smith in the power of putting an incongruity in an irresistibly ludicrous light. Thus, when he wished to show how inapplicable poetical sentiment was to the relief of the wants of Ireland, he said—"What is the object of all government? The object of all government is roast mutton, potatoes, claret, a stout constable, an honest justice, a clean highway, a free chapel. What trash to be bawling in the streets about the Green Isle, and the Isle of the Ocean—the bold anthem of Erin-go-bragh! A far better anthem would be, Erin go bread and cheese! Erin go cabins that keep out the rain! Erin go pantaloons without holes in them!" There is one form especially characteristic of humorous speech, viz., what the Greeks call *litotes*, (or simplicity,) the Latins, a pregnant saying, and which enters into many shrewd, quaint proverbs. I mean what is sometimes called reticence, saying much less than is meant, indirectly indicating a vast deal more than is directly expressed. The sense of humour here seems to delight in the contrast between the trifling and homely thing said, with the extent and importance of the truth implied. Thus, when a party of persons had been abusing Oliver Cromwell, and wound up by asking what good he had ever done, a quiet Scotchman replied, "He gar'd kings ken they had a crick i'their neck." Here the humour lies in the grim contrast felt between the seemingly trivial truism expressed and the solemn sternness of the lesson taught, that

kings have their duties and responsibilities no less than other men. This species of humour is peculiarly akin to the cautious phlegm and thoughtful shrewdness of the Scotch.

An opposite form of humorous speech is that of grotesque exaggeration, in which our American friends are especially prone to indulge. There is much genuine and exquisite American humour in Sam Slick—grotesque and unexpected ways of expressing deep, proverbial truths. Humour is generally of an earlier and more spontaneous growth than wit, abounding in old legends and ballads, and always rendered more racy by being expressed in a provincial dialect, because this adds to the piquancy of the incongruity. A provincial dialect is associated in our minds with ignorance and want of culture. Hence the expression of a shrewd thought or an unexpected unfitness, in what we are accustomed to consider the coarse, homely garb of a rude dialect, sets off the incongruity still more strongly, and heightens the sense of surprise.* There is rich humour in the Lancashire dialect, as exemplified in the songs which it contains, and the homely shrewdness of the people.† The late Dr. Shepherd, of Gateacre, was one of the most genuine humorists whom I ever had the pleasure of knowing. It was hardly possible to be an hour in his company without hearing a rich, racy anecdote. I remember one of his anecdotes which illustrates at once the peculiar humour of Lancashire, and also the essential nature of that unexpected incongruity in the midst of the deepest seriousness, in which true humour consists. A clergyman was visiting a poor old woman in his capacity of spiritual adviser, and warning her of the outer darkness in which is weeping and gnashing of teeth; whereupon she said, "Let them gnash

* An illustrative Scotch anecdote was here quoted from the late Mr. John Wilson.

† An illustration was here given from the song of the "Oldham Cotton Weaver."

'em as *has* 'em."* As familiar examples of humorous effect, I may refer to the Irishman's journey in a sedan chair which had lost both seat and bottom, who gave it as his opinion that if it was not for the name of the thing he would just as soon walk; and the method of sweeping chimneys by dragging a live goose from top to bottom by a rope tied round its neck, with the addition that if this be objected to on the score of cruelty to the goose, a couple of ducks will do very nearly as well.

Humour consisting in the perception of an unexpected incongruity, it is of course most keenly felt when a tragic or solemn occasion is suddenly interrupted. Mischances on the *stage* sometimes afford this enjoyment more intensely than anything in the performances themselves. Thus, the actor mentioned in the Memoirs of Tom Moore, who was playing *King Lear*, and uttering the bitter words, "How sharper than a serpent's tooth it is to have a thankless child!" by a slip of the tongue said, "How sharper than a serpent's *thanks* it is to have a *toothless* child!"—and the audience were so much delighted with the blunder that whenever he acted the part afterwards they compelled him to repeat it.†

In the "Cruise of the Midge," a Tale which appeared many years ago in *Blackwood's Magazine*, there is a long and well-told story of a Scotch preacher, called an "Episode of the Stick Leg," which is full of the richest humour, besides containing much truth and tenderness.‡ A book lately published, called "The Curiosities of Food," contains an incident at a Scotch funeral, exactly exemplifying that peculiar incon-

* Wood's Poem, "The Flower," with its allusions to Mungo Park and Burns's Daisy, and its unexpected conclusion, was here quoted for its humorous effect.

† An illustrative extract was here given from "Behind the Scenes; or, the Confessions of a Strolling Player," describing a ludicrous *contretemps* that once occurred at the Edinburgh theatre, during the performance of *Othello*.

‡ An abridged extract was here given.

gruity in which humour delights.* If any of my audience think me *irreverent* in adducing the above illustrations of humour, I beg to repeat that the very *contrary* is the fact. It is the very appreciation of the solemnity of the occasion that gives its full zest to the ludicrous incongruity. No man can properly enjoy humour who cannot deeply feel the tragic elements of life. "Man," says Hazlitt, "is the only animal that laughs and weeps." The late Rev. F. W. Robertson, of Brighton, says, "There is a deal of religion in an earnest, hearty laugh, that comes ringing from the heart."

I remarked above that a stroke of refined wit sometimes verges upon poetry. All true poetry must spring from excited feeling, and be the expression of passionate thought. But that is not in itself enough, because a man may be under the influence of excited feeling, or passion, without expressing himself poetically; there must further be an effort of imagination, seeking an indirect expression in some unexpected and beautiful analogy. I will pass briefly over this part of my subject, as I endeavoured to illustrate what I conceive to be the essential characteristic of poetry in a paper already read before this society, and printed in vol. X of its transactions. Wit and poetry approach one another's confines, and it may sometimes seem difficult to draw the boundary line between

* A minister, on his way to a funeral, at which he had to officiate, called to see an old widow lady, one of his parishioners, who had just been making some sausages, on which she rather prided herself, they were so plump, and round, and sweet. Of course, she insisted on the minister taking some of them home to his family; and, after wrapping them in a rag, carefully deposited a bundle in each pocket of his capacious great coat. Whilst he was performing the solemn service at the grave, some hungry dogs scented the sausages, and soon traced them to the good man's overcoat, annoying him so much that he had repeatedly to kick them off. After the service at the grave, all repaired to the church, where the sermon was to be preached. When the minister was in the pulpit, an elder, who wished to have an appointment given out, ascended the pulpit stairs and gave the minister's coat a gentle pull to attract his attention. The minister, thinking it was one of the pertinacious dogs again, gave a sudden kick, and sent the good elder sprawling down the stairs. Then, without looking to see what he had done, he gave this explanation to the congregation.—"You will excuse me, brethren and sisters, but I have sausages in my pockets, and *that dog* has been trying to grab them ever since I came upon the premises."

them. A flash of wit prompted by glowing eloquence and indignant invective, often approaches the region of poetry; and a poetical conceit, if too coldly ingenious, partakes rather of the nature of wit. Each surprises us with an unexpected analogy, but true poetry must always *delight* as well as surprise, gratifying our sense of beauty, or exciting some emotion in the heart. In my former paper I endeavoured to show that it was of the very essence of poetry to be true *subjectively*, while fictitious *objectively*—true as an expression of a sentiment or feeling in the mind, whilst only fanciful or well invented in regard to the manner of expression. As a single illustration, I may adduce the motto of a sundial at Venice, "*Non numero horas nisi serenas*,"—"I count not the hours unless they are bright,"—together with the opposite aspect, not less poetical, in which the same object is looked at by Butler, in his *Hudibras*—

> True as the dial to the sun,
> Although it be not shined upon.

Here, in the first instance, the mind is delighted with the apt and fanciful personification of the sundial, (from the simple fact that it indicates the hour only when the sun is shining,) as though it had a disposition to reckon life only by its happy hours; and in the second instance the mind feels it to be an equally skilful and appropriate detection of a poetical analogy to invest the sundial, (from the fact that it always points right, whether the sun shines or not,) with the moral characteristic of steadfast fidelity, that does not forget or swerve from its object when clouded by adversity.*

* A third poetical aspect of the sundial is given in the following lines from Wordsworth's "Evening Walk," one of his juvenile pieces; conveying, however, rather a morbid sentiment.

> "Alas! the idle tale of man is found
> Depicted in the dial's moral round;
> Hope, with reflection blends her social rays,
> To gild the total tablet of his days;
> Yet still, the sport of some malignant power,
> He knows but from its shade the present hour."

Every true poet is a man of genius, though a man of genius may not be what we call a poet. Each of them is not essentially different from common meu; he is only more a man than common men. He perceives more acutely, conceives more vividly, or feels more deeply. "Poetry," says Shelley, "lifts the veil from the hidden beauty of the world, and makes familiar objects be as if they were not familiar." And Coleridge has well said, that "To carry on the feelings of childhood into the powers of manhood—to combine the child's sense of wonder and novelty with the appearances which every day for perhaps forty years has rendered familiar—this is the character and privilege of genius, and one of the marks which distinguish genius from talent." A man of talent, it has been said, is a man who can do well and quickly that which other men do with less ease; but a man of genius does that which other men never think of doing at all, although they admire and applaud it when done. He strikes out a new line of thought, makes an original discovery or invention.

I think one of the most wouderful examples of genius was the discovery by Galileo, that the huge earth on which we walk, and which seems to our senses so boundless and so immoveable, is by comparison a small globe revolving round the sun. Only the highest geuius could enable a man to rise so completely above the impressions of the senses, and discern with eagle-gaze the invisible and eternal truth through the veil of visible and temporal appearances.

Again, the theory of gravitation by Sir Isaac Newtou—the thought that there is no apparent reason in the nature of things why a body must move downwards when left to itself, rather than upwards or sideways—and the inference of a power of attraction between all bodies, by virtue of which an apple falls to the earth, and the planets are guided in their courses,—this seems to me one of the most admirable triumphs of genius. Columbus, with his fixed idea that there must be

land beyond the Atlantic, and his patient struggles with all the opposition, discouragement, neglect, and ill-usage he had to encounter in the working out of his great idea, is another memorable example of true genius. So was Benjamin Franklin, boldly flying his kite in the thunderstorm to identify lightning with electricity. So was James Watt, the patient and profound philosopher who created the steam-engine. So was George Stephenson, who dared to encounter the fire-damp with his safety lamp; who felt in himself that steam could be economically applied to railway locomotion, and who persevered, in spite of every hindrance from the ignorance and from the science of his day, till he had created our present railway system, which has effected so wondrous a revolution in the whole civilised world.

Carlyle, in his life of Frederick the Great, says that genius is "a transcendent capacity of taking trouble first of all;" and it is true that genius consists not in the mere striking-out of an idea, but in the stedfast fixedness with which the idea is clung to, in the passionate earnestness with which the heart is set upon it, and every possible resource brought to bear upon it, as a thing that can and shall be accomplished, and in the unshaken determination with which it is worked out in spite of all difficulties, obstacles, and discouragements.

It is to men of genius that we owe all the great ideas which enrich our daily life, and take their place amongst our household words, all the great discoveries in philosophy, all the great inventions in art, all the great productions in fine art, all the great achievements of the human soul in poetry, eloquence, music, painting, and sculpture, which make the difference between a savage and a civilised people.

Genius sometimes takes the form of a profound and earnest moral conviction, like that which impelled John Howard, for example, to devote himself to the work of reforming and humanising the management of prisons, or Elizabeth Fry and

Joseph Tuckerman to establish the principle, that there are elements even in the most depressed and corrupted human soul, which may be raised and redeemed, if appealed to with the hopeful, loving and persevering earnestness of brotherly and Christian sympathy.

As science finds it increasingly difficult to draw an exact boundary line between distinct orders and species of organised creatures, however sure we may feel that they are distinct, and that there is somewhere, however hidden from human sight, a line of demarcation, so it is very difficult to distinguish genius, in its highest and rarest forms, from inspiration, though, of course, we regard the one as among the natural, whilst we define the other to be among the special and exceptional, gifts of God. In a more general sense, indeed, "there is a spirit in man, and the inspiration of the Almighty giveth him understanding." Man is the image of his Maker, and his highest glory is faintly to reflect his source. "Every good gift is from above, coming down from the Father of lights," of whose surpassing glory the brightest flash of human genius is but a feeble and broken ray.

It is left to man to make a good or bad use of his noble gifts. Genius may be turned to noble uses, for the wellbeing of man or to the glory of God; or it may, alas! be perverted to subserve selfish and unprincipled ambition, or fiendish or ruthless war.

Men of genius—as if to warn us of the dangers and responsibilities accompanying the rarest gifts—are often subject to some peculiar irritability, infirmity, or defect; victims, perhaps, of some pernicious habit or destructive passion. It is for them to guard against such dangers, and to check in themselves such propensities—not to suffer their great good to be evil-spoken of—and thus to preserve the precious gift committed to them unsullied and unimpaired. It is a miserable mistake, however, for others to imagine that these are among the essentials of genius; and to affect trivial peculiarities and

infirmities, still more, to run into reckless and dangerous excesses, with a view of resembling men of genius, is to the last degree ridiculous and contemptible. It is as if a bramble, on the score of its thorns, should claim credit for the sweetness and beauty of the rose.

In the discussion which followed, it was observed by Mr. CLARK, that there was a definition of wit which had always struck him as very appropriate. He believed it was Addison who defined it as being the expression of that which was natural but not obvious. He thought this was very admirable. The best proof of a saying being witty was, that every one, immediately on its being uttered, should at once perceive its naturalness, and that it should excite a sensation of wonder that it had not been said before.

Which oft was thought before, but ne'er so well expressed.

He thought there was no necessary connexion between wit and humour. On the contrary, many of those writers who were most remarkable for wit were the least remarkable for humour. It occurred to him that the poets who were most remarkable for wit, Dryden and Pope, were not fairly to be classed as humorous poets. The perception of intricate and delicate analogy was very frequently found in minds which would disdain that perception of incongruity in things essentially similar, which Mr. Robberds had defined as the characteristic of humour. He could not allow that the highest form of wit was inseparably connected with the highest form of excellence in poetry and eloquence. It would generally be found that the highest form of poetry and eloquence was that which fixed the mind the most strongly on the particular object in the mind of the speaker or poet; which fixed the mind of the hearer or reader on that particular conception, without allowing it to be drawn off by those minor analogies which might be suggested by an inferior speaker or writer.

He differed from what Mr. Robberds had said as to excitement being always an accompaniment of poetry. Shakespeare, it was true, had spoken of "the poet's eye in a fine frenzy rolling." But with regard to some of the highest poetry, it was utterly impossible to conceive of its being written in a state of intense mental excitement. For example, no one would believe that Tennyson's poem the "Idylls of the King," was the product of an excited state of mind. He believed that Dr. Johnson had said that genius was nothing more than the bent of a strong mind in a particular direction. There was a great deal of truth in the saying, If they could analyse the mental constitution of a man of genius, and trace the successive steps by which he had arrived at that consummation which was the evidence and proof of his genius, they would find that his mind had taken that particular direction from some accidental circumstance, arising either from his position in life or some other external cause, and had been led to fix itself almost exclusively upon that one idea, and so that effect was produced which people called genius. With regard to the power of invention, as marking the necessary difference between a man of talent and a man of genius, there were many instances which would scarcely bear out that view. No one would deny that "Paradise Lost," was a work of great genius, but it was inferior to many that might be named as a work of invention. Mr. Robberds had alluded to George Stephenson, in his enumeration of men of genius. But George Stephenson himself invented little. His great merit was, that he discerned the value of the inventions of others, and combined and managed them so as to do that which the inventors had hitherto failed to do,—render their inventions practicable and efficient. To discern the hidden uses of things—to breathe into dead forms a new vitality—to evoke from familiar agencies grand and unexpected results—these were as much the marks of genius as the capacity of invention.

No, neither

EIGHTH ORDINARY MEETING.

ROYAL INSTITUTION, 23rd January, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Dr. IHNE laid before the society the most recent chart of San Juan, from the German geographical work of Petermann, which is in course of publication at Gotha, (December, 1859.)

Professor ARCHER exhibited a binocular telescope, by an Italian optician of the last century, bearing date 1726, which had been discovered in the collection of the Royal Institution.

The following papers were then read :—

By Professor ARCHER—the third of his series on ECONOMIC ZOOLOGY—

PRODUCTS OF THE CARNIVORA.

By Dr. EDWARDS—the first part of his paper,

ON MAGNETIC LIGHT,

which was continued at the following meeting. (See page 134.)

NINTH ORDINARY MEETING.

ROYAL INSTITUTION, 6th February, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Dr. THOMSON exhibited two interesting specimens of snakes, one of which measured six feet six inches in length, and had been killed while swimming round a ship about three miles

from the island of Trinidad. The other specimen had been sent for exhibition by Mr. Moore, the curator of the Free Public Museum, who stated, in a letter accompanying the specimen, that it was one of the compressed-tailed sea-snakes, the *Pelamis bicolor;* a species originally described by Quindus as the *Anguis platura,* and subsequently placed in the genus *Hydrophis,* but afterwards separated therefrom on account of its long and depressed head, and wide gape. The specimen exhibited by the Secretary, Mr. Moore said, was quite new to our series, but appeared to be allied somewhat to the American genus *Herpetodryas.* Further examination and comparison, however, were necessary to determine it. The two specimens exhibited, represented two distinct forms of ophidians. The *Pelamis* having the tail compressed, and the belly covered with scales like those of the back, belonged to the family *Hydridæ,* consisting of the genus *Hydrophis* and other genera; the other, having the tail rounded, and the belly covered with broad plates, or scutæ, belonged to the Colubridæ, represented by our common British ringed snake. The outer row of teeth in the upper jaw of the Trinidad specimen were small, and uniform in size, and no poison fangs could be detected. The Hydrophides, on the contrary, were highly poisonous.

The following papers were then read—

ON BIRDS WHICH NEST IN THE DISTRICT.

By J. FITZHERBERT BROCKHOLES, Esq.

Birds, owing to their beauty, variety and song, combined with their graceful elegance of form and action, have ever been favourites with man in all stages of his existence. A child in the nurse's arms, puts forth its hand to take the robin off the post; youth uses various traps, nets and birdlime to catch

them; whilst man pursues them for the cage, museum, the table, or for sport. The varied habits of different species with their high instincts, give them further charm in the eye of the naturalist. To him, also, the earliest song of resident species in each succeeding year, and the first appearance of migratory summer visitors always has its interest. The first nest of each will give to him a pleasure, second only to that of finding a new and desired acquaintance amongst the feathered race. And what a charm there is about the unsullied fresh-laid eggs when seen in their artfully-finished resting place.

Those birds which have their home within a circuit of ten miles from the Liverpool Exchange, and from Woodside Ferry on the Cheshire side, are the subjects of this paper.

Owing to the increased population and the consequent changes in the locality, some tribes are met with now in fewer numbers than formerly. This is due to the wild nature of the birds, causing them to retire from the vicinity of man; and also, to the relentless persecution to which they are subjected on all sides, and at all seasons. Amongst these are the *Falconidæ*, two species of which, or three at most, now remain here to breed.

The kestrel, (*Falco tinnunculus*), one of the most beautiful, interesting, and harmless of hawks, is not an uncommon resident. It may sometimes be seen hovering for a few minutes over a spot where a mouse is seen or expected. Mice and insects are its principal food, and though not quite guiltless of feather, it is more useful than otherwise, and should therefore be protected. Generally, each succeeding day will find it hunting the same ground, at the same hour, and following the same course. This bird is rarely, if ever, its own architect, but selects and repairs an old nest of the crow, magpie, or any other which is sufficiently large. Rocks, ruins, and trees in woods are alike the chosen situations. Last spring, I constantly saw a male bird in a large rookery,

where he lived in harmony with his neighbours. His mate probably occupied a rook's nest. The usual five eggs are laid in April, and are subject to considerable variation. They are reddish buff, spotted, and blotched with darker shades.

The sparrow-hawk, *(Accipiter nisus,)* is a much more bold and destructive bird; it is also extremely cunning and wary. A pair may be met with in most suitable woods, where they are not molested. Blackbirds and thrushes seem their favourite food, and when a bird is captured, it is conveyed to an eminence, sometimes to an old nest, should there be one near, and there devoured. They build a large, spreading and rather flat nest of sticks, lined with fibres, usually in a tree which commands a good view in every direction. The various species of fir are favourites for the site: should the first nest be robbed, they will sometimes build a second, or even a third. At other times, an old one will be selected and repaired, whilst occasionally, any accumulation of dead leaves remaining in the tree will be chosen. I have known them also return to a nest they had forsaken a fortnight previously. They are easily made to forsake, as the insertion of the hand in the absence of the bird is alone sufficient. In this, cunning and caprice are well exemplified characteristics. The eggs, five in number, are laid in April, and are subject to very great variation. The type is greenish white, blotched with reddish brown. During incubation, feathers and bits of down are accumulated to a great extent about the nest. These do not form part of the original lining.

A kind of harrier may be often met with in the district, and is well known to gamekeepers as the blue hawk. I have seen specimens, but have never been sufficiently near to be able to identify the species. This, or a similar bird, I am told, breeds regularly a few miles off, so that a pair may occasionally nest here.

Old prejudices against owls are fast disappearing, and they

are now considered to be not only harmless but useful. In many districts they are not molested, and in some they are protected. Two species are resident, and two others are doubtful. These are early nesters, frequently having young before the middle of April.

The white, or barn owl, *(Strix flammea)* is generally distributed; is not uncommon, and is one of the most useful of birds, its food consisting principally of mice. It frequents farmsteads, rocks, quarries and woods; in the last, roosting in evergreens. Frequently the same dormitory will serve for a length of time. This bird builds no nest but lays its eggs on the accumulation of its own castings. The spot has generally a very fetid smell, and is often in a dovecot, barn, hayloft, &c., and sometimes in the face of a rock. Owls are soft-winged birds, and therefore make no noise in flight. This is probably due to the quills partially overlapping each other, rather than to any peculiarity of feather. In those birds whose flight is heard, the quills are separate, and the noise arises from the currents of air passing between them. Should there be one or more quills absent, the noise is greater. This is easily observed in the rook. Owls are therefore admirably adapted for taking their prey. Whilst flying in search of food, the barn owls constantly make a kind of loud hissing noise with their mouths, which is a remarkable habit The fact of their wing and leg bones being sometimes, if not invariably, without marrow, is also curious. The eggs of all the British owls are white.

The long-eared owl *(Otus vulgaris,)* is another resident species which is found in most suitable woods. This bird is also very useful, its food consisting principally of mice with an occasional finch. It seeks gloomy and retired places, roosting in various evergreen trees and bushes, or even in old gorse. Unlike the preceding species, it seldom resorts to the same dormitory for many days in succession. It is very

wary and has very acute hearing. When disturbed, the tufts on the head are raised, and maintained in that position whilst the cause continues. The long-eared owl is seldom its own architect, but generally selects and repairs the old nest of a hawk, magpie, or woodpigeon. The eggs, two to four in number, are laid in March or April, sometimes on consecutive days, and sometimes at longer intervals. During incubation, which commences from the laying of the first egg, feathers and down are accumulated about the nest, and the old bird sits exceedingly close,—so closely in fact, that last Spring I had great difficulty in distinguishing one on the nest of a woodpigeon. The parent birds continue to feed the young ones for a long time after they have left the nest. Last Spring, I had the pleasure of watching a brood, and it was very interesting to see them in the evenings and to hear the various notes used by the old and young birds. It was evident from their manner and actions, that these notes were used in conversation, and that each had a very significant meaning. The bones in the first joint of each wing in this species contain no marrow, but all the others with those of the legs do.

The short-eared owl *(Otus brachyotus,)* is sometimes met with, and may occasionally breed on the mosses or sandhills.

The tawny owl *(Syrnium stridula,)* also occurs in the district and is probably resident, but I have not as yet met with a nest.

The red-backed shrike *(Lanius collurio,)* is an occasional visitor. A pair reared five young near Bidston, a few years since, and afforded much amusement, though I did not see the nest. The eggs are pale buff, variously spotted with grey or reddish brown.

The spotted flycatcher (*Muscicapa grisola,*) is a summer migrant and constant visitor. It is a confiding bird, sometimes taking up its abode in the localities most frequented by

man. Perched almost motionlessly on a bare branch, it will often fly at a passing insect and return to the very spot so lately left. Were it not for this peculiarity, the unobtrusive habits and sober plumage would seldom attract notice. Few other birds have more local names. It is not necessary to enumerate all, but wall bird, wall pecker, woodpecker, and cherry picker are examples. These names generally have reference to some real or supposed habit, and are sometimes entirely erroneous; this bird, for instance, having no affinity with the woodpeckers. The nest is without beauty, but great skill is shown in adapting it to circumstances, since various and sometimes curious places are chosen for the site. Holes in walls and trees, depressions on horizontal branches, niches in the sides of quarries or earth-banks, hinges of garden doors, and ordinary situations in trees or ivy are amongst the number. The materials are also very diversified, moss, cobwebs, &c., being used according to situation and circumstances. The eggs are very variable, and five form the complement. They are greenish white, suffused, spotted or blotched with reddish brown.

The thrush (*Turdus musicus,*) is a well-known and common resident. Its nest is made of grass or moss, lined with mud, and seldom, if ever, varies. The locality chosen for it is in a hedge or isolated bush, though not unfrequently it is placed high in a tree or on twigs growing from the bole. Occasionally, aberrant situations are resorted to, such as bare banks or level ground in woods or fields. I remember finding one which was built on the ground, in the middle of a large meadow and at a long distance from any bush. It was sunk in the ground like a lark's. A nest found last Spring, was sunk in level ground in a wood, and had nothing to shelter it but a little trailing ivy. Strange to say, the parents were rearing only one young one. I have seen another, containing eggs, in the cavity of an old magpie's nest. There is little or no attempt

at concealment, and though of common-place appearance, few others have more charm. The eggs, five in number, are greenish-blue, with black spots.

The missel thrush (*Turdus viscivorus,*) is also abundant, and is the first to commence singing in Spring. It is not a favourite with country people, on account of the song being so often heard in hard weather. Stormcock is a common local name. The nest is often built in March, though April is the principal month. It is a solid structure, composed of grass, moss, bracken, &c., lined with mud, and internally with the soft portions of grass. There is very frequently a piece of white rag, wool, or paper, hanging from the outside. Occasionally, twigs are extensively used in the construction; and in this case, the nest, at a little distance, has much the appearance of a jay's. The favourite situation is a fork, at any elevation, in a timber or orchard tree, but sometimes the top of a pollard is chosen. The eggs, two to five in number, vary very much. They are greenish, or pale buff, marked with leaden-gray and reddish-brown. In Spring, this bird is often confiding, and few are more bold and daring in defence of their nest or young. In Summer, it is the constant frequenter of fruit trees, especially seeking the early pear, cherry, gooseberry and currant. In Autumn, the various families become associated, and often form large flocks, frequenting the more retired districts. At this season and in winter, few birds are more wild, wary and distrustful.

The blackbird (*Turdus merula,*) seems to be more numerous now than formerly. This may be due to the increase of shrubberies and other places suited to its retired habits. The song is loud, and similar to that of the missel thrush, but is more mellow and pleasing. It is occasionally uttered whilst the bird flies from one tree to another. The nest is composed of moss, lined with mud, and internally with the soft portion of grass. Sometimes grasses and fern leaves form the outside.

Busbes in retired places are the favourite situations, an though trees are sometimes resorted to, a nest at any materi elevation is rarely found. I have seen only one that was a high as about twenty feet. Occasionally, a nest is built on retired bank, sheltered merely by a little trailing ivy, or spray of honey-suckle. The eggs, four or five in number, a subject to great variation. Typical ones are greenish, freckle and spotted all over with grayish brown. The blackbird is great telltale, as it is very noisy on being disturbed.

Two pairs of the ring ouzel (*Turdus torquatus,*) the or near Bidston, and the other near Tranmere, have come withi my notice. It is probable that these had nests though I d not find them.

Autbors do not admit that the fieldfare (*Turdus pilaris* nests in Britain, but as I have seen one on an unfinished nes at Maghull, I mention the bird here. Fieldfares roost e tensively on the ground, and I have flushed many from roug herbage on ditch sides at night.

The well-known hedge sparrow (*Accentor modularis,*) nee little comment. Thick bushes are the favourite situations f the nest, which is composed of moss, lined with hair. Five the spotless blue eggs form the complement, and two broo are reared in the season.

The robin (*Erythaca rubecula,*) familiar to every one, a the constant attendant upon gardeners, sings throughout t year, though owing to the prevalence of song during t spring and early summer, it is less heard at those seasons th at others. Pugnacity is an inherent quality in this bir whose fights with rival robins frequently end in the death one or other of the combatants. There is little doubt th this has given rise to the fable of the young ones killing the parents. The nest, composed of moss and dead leaves, line with hair, is placed on a bank under the shelter of pende grass. Occasionally, the side of a haystack, a hole in a wa

or some such aberrant situation is chosen. I have found them in ivy. The eggs, four to six in number, are pale cream-colour, marked with reddish brown, and are very variable.

The redstart (*Phœnicura ruticilla,*) is not an abundant visitor to the district, since a few only are anually found in the neighbourhood of Eastham. Though a summer visitor, I once met with a female specimen on the Leasowe Embankment during severe weather in winter. The eggs are spotless blue.

The stonechat (*Saxicola rubicola,*) is abundant during the summer months. Though the majority leave us in autumn to winter in more genial climates, a few remain here all the year. The stonechat, for the most part, affects wastes where gorse grows freely, and where it may be constantly seen indulging in short flights from bush to bush, uttering its twice-repeated, sharp, loud note, whilst alighting on the topmost spray. The song is insignificant. The nest is placed at the foot of a furze, or other thick bush, or amongst rough grass, and is difficult to find, though the birds always betray the neighbourhood. Five or six, most frequently the latter, are the complement of eggs. They are greenish blue, freckled over with brown, and are subject to variation. Two broods are reared in the season.

The whinchat (*Saxicola rubetra,*) is also a common visitor, and affects hedges, with habits similar to the preceding species. It always leaves us in autumn. The nest, composed of grass and moss, lined with the soft portions of grass, is placed amongst rough herbage, on a bank, and is difficult to find. I have met with one built like a lark's in an open field. The eggs, ordinarily six in number, are like those of the stonechat, but with fewer and sometimes more distinct spots. Two broods are reared in the season.

The wheat-ear (*Saxicola œnanthe,*) is also plentiful in summer, though less so than formerly. It is a ground-loving

bird, and rarely, if ever, alights upon a tree or bush. Like the chats, the wheatear takes short flights, alighting with a loud though not unmusical note upon a clod, stone, or wall. Open pasture lands, downs, and sandhills are its favourite haunts, and there it may be seen, now running a few yards, then perching with many gesticulations and notes, upon an eminence. Though this bird is the first to arrive in spring, and the last to leave in autumn, I am not aware that it ever remains during winter. The nest, composed of grass, and lined with the softer portions, is placed under a hollow bank or in a hole. When in the latter situation, it is seldom found except by the insertion of the hand In looking for it, it is well to be mindful of newts and toads. The usual five pale blue eggs do not vary.

A few pairs of the grasshopper warbler (*Salicaria locustella,*) annually visit the neighbourhood of Birkenhead. Owing to shy and retiring habits, it is seldom seen, though the peculiar note may be often heard, and perhaps as often mistaken for grasshoppers, or the machines set in cornfields to frighten birds away. The evening is the best time to observe this warbler, as it then becomes more bold. The observer must remain very quiet, otherwise he scares the bird, and perhaps sees no more of it. At a little distance, the grasshopper warbler looks not unlike a small, slender, restless hedge-sparrow. The nest is very difficult to find, and the only one I ever saw was in the bottom of a bush. I do not remember of what it was composed. The eggs are pinkish-white, freckled over with a darker shade.

The sedge warbler (*Salicaria phragmitis,*) is a common summer visitor, and well-known frequenter of weedy ponds and ditches. Its habit of singing at all hours of the night, as well as day, especially when disturbed, has often been mentioned by naturalists. The rather deep nest is composed of grasses, lined with hair. It is generally well concealed

amongst the luxuriant herbage growing in the places affected by the bird. The mottled, pale brown eggs, five in number, are variable.

The reed warbler (*Salicaria arundinacea,*) is also an annual visitor, which may generally be detected in greater or less plenty. As the name implies, it is partial to beds of reeds, where shy and retiring habits cause it to remain concealed during the day. As evening advances, this bird becomes more bold and lively, frequently perching against the upright stems in the margin of the reeds, or on the tops in the middle of the bed. The ordinary note is harsh, but the reed warbler sometimes imitates other birds, and sings beautifully. I have heard it on several occasions, produce a fascinating song at midnight,—a song totally unlike any other I have heard. Perhaps the still hour of midnight enhanced the charm; though if it had been noon, I think the hearer would have stood to listen. This song may have been in imitation of the famed nightingale, but never having heard this bird, I cannot say. Early in September, 1857, a great many reed warblers were congregated in a bed of reeds, on Bidston Marsh, probably preparatory to their migration. The deep nest is ordinarily suspended between three reeds, and is composed of the leaves of this plant. The eggs vary and are greenish-white, mottled with olive brown.

The blackcap warbler (*Curruca atricapilla,*) though an insectivorous summer migrant, is rather partial to small fruits when ripe, and on that account is not a favourite with gardeners. The shallow nest is a slight fabric composed of grasses, lined with a little hair and one or two bits of wool. It is built in a thin bush without the slightest attempt at concealment. The eggs vary and are buffish white, marked with two darker shades.

The common whitethroat (*Curruca cinerea,*) is abundant in summer. The nest is similar to the preceding, but deeper

and composed of more materials. It is generally well concealed in a bush, isolated "tussock" of grass, &c., in woods or elsewhere, and often amongst rough herbage by a ditch side. The eggs are very variable, and are greenish-white, marked with deeper shades.

Eggs of the lesser whitethroat (*Curruca sylviella,*) have occasionally been brought to me from the neighbourhoods of Wallasey and Leasowe. They are dirty white, spotted and blotched with various darker colours. The bird visits the district sparingly.

The wood warbler (*Sylvia sylvicola,*) was plentiful at Bidston, last summer. This bird seldom wanders far from the neighbourhood of its nest, which is placed on, or near the ground in woods. It is domed half over, and very difficult to find. The eggs are white, much spotted with purple-brown.

The chiff chaff (*Sylvia rufa,*) was also plentiful last spring. In habits it is a good deal similar to the preceding, but seems partial to larch firs. Owing to lively and active habits, and a tendency to go high in the trees, it is difficult to observe. Its note may be sometimes mistaken for that of the tits. The nest, composed of grass, lined with feathers, and domed half over, is placed on or near the ground, within the margin of a wood, and is very difficult to find. The eggs are white, spotted with purple-brown.

The willow warbler (*Sylvia trochilus,*) is abundantly distributed through the district in most summers. Few other birds have a more pleasant song, or add more charm to spring. At the approach of, and during rain, the willow warbler seldom sings, but uses an often-repeated plaintive chirp. The domed nest, composed of grass or moss, lined with feathers, is placed on the ground near trees or bushes. I found one last spring built in the middle of a large dense "tussock" of grass, with an entrance not unlike a mouse's

hole. Whilst examining it, the birds were very bold, and several times struck at my face. Another nest was built in a hedge at a considerable elevation. The eggs are numerous and very variable. They are white, spotted with orange-red.

The hardy little golden-crested wren *(Regulus cristatus,)* is an abundant resident in the fir woods on the Cheshire side. It is gregarious in winter, and is one of the earliest to commence singing in spring. The song, as well as the ordinary notes are pleasing. The nest is amongst the most beautiful, small and compactly made of moss, lined with feathers, it hangs suspended from a yew or fir branch, several of the lateral sprays being woven into the material. Occasionally it is suspended in a furze, or Irish yew bush, and sometimes several are built in the same favourite spruce. The eggs are numerous, and are very pale buff, shaded with a deeper tone at the larger end.

The great tit *(Parus major,)* blue tit *(Parus cœruleus,)* and cole tit *(Parus ater,)* are common residents, with habits so similar that one notice will serve. Their song is insignificant, but nothing can exceed their restlessness and graceful actions whilst in search of food. All positions seem alike—whether perching ordinarily, clinging to an upright wall or tree, or hanging with back downwards. When insects fail in autumn and winter, they feed extensively on seeds, extracting them with equal adroitness from rose hips, and other berries, teazle and wild carrots. The blue tit often repairs to houses to pick the thrown out bones. When a boy, I often watched them into the tubes of beef shins and caught them there. The nests of all these species are composed of a little grass or moss, lined with a profusion of feathers, and are placed in holes in walls or trees, behind loose bark, or occasionally in or about the old nest of a crow or magpie. The eggs are numerous. I have heard of twenty-nine being found in one nest of the blue tit, but these were probably laid by two birds. Those of all three species are white, spotted with red.

The marsh tit (*Parus palustris,*) will have habits similar to the preceding, and is probably resident. I have noticed it only in winter whilst feeding on stunted reeds, teazle, and wild carrots.

The long-tailed tit (*Parus caudatus,*) is resident, and differs from the others of the genus in being gregarious in winter, and in making a domed nest in situations similar to most other birds. The nest is a beautiful structure, sometimes curious, and has acquired for the architect the names of featherpoke and bottle tit. It is sometimes like a wren's; at others, it is shaped like a bottle suspended from a branch. It is frequently composed of moss and lichen beautifully blended, and sometimes it is of moss simply. The lining is always a profusion of feathers. The white eggs are shaded or freckled with reddish brown and are numerous.

The pied wagtail (*Motacilla yarrellii,*) is a well-known and interesting resident, affecting the sides of waters, swamps, fields, yards, and gardens. The sites chosen for the nest are as varied as the haunts;—holes in walls, the sides of quarries, amongst stones, furze bushes near water, and the wicker fencings made to protect banks are amongst the number. The white eggs, five in number, are dotted over with gray. In autumn and winter, pied wagtails collect in abundance amongst reeds for the purpose of roosting. The quantity of birds, species as well as individuals, resorting to a bed of reeds in an autumn evening to roost, is truly astonishing. To stand quietly by and see the flights of swallows, martins and sand martins, the many individual marsh birds, buntings and wagtails, dropping in from all around, is certainly a curious sight. One would be puzzled to know where all came from, or how all found a footing.

The grey wagtail (*Motacilla boarula,*) is also resident though not abundant. One or a pair may be met with by the sides of most streams, in a bank of which the nest is ordinarily placed.

The yellow wagtail (*Motacilla rayi,*) visits the neighbourhood in spring in considerable numbers. For a few days after their arrival, the flocks remain together for the purpose of pairing. I have seen some half-dozen, no doubt rivals, fighting together. They soon disperse amongst the corn fields and other ploughed lands, to take up their residence for the summer. The nest is placed upon the ground in a furrow, or behind a clod, and is composed of grass lined with the softer portions. The mottled pale brown eggs are variable, and five form the complement.

The tree pipit (*Anthus arboreus,*) annually visits the district in greater or less plenty to spend the summer. The bird will often rise perpendicularly from its perch upon a tree, and whilst descending in a slanting direction will utter a rather pleasant song, some notes being not unlike those of the canary. The nest, composed of grass lined with the softer portions, is placed upon the ground under the shelter of a bush or tuft of grass. The eggs are very variable. The standard is pale reddish gray, blotched with two or three darker shades.

The meadow pipit (*Anthus pratensis,*) is an abundant resident. Unlike the preceding, this species frequents the open country rather than the neighbourhood of trees. In winter, numbers may be met with in swampy places, and by stream sides, where food is more easily obtained. Large flocks, perhaps associated for the purpose of pairing, may be met with in early spring. The song is uttered on the wing whilst the bird descends in an oblique direction to the ground. The nest, composed of grass lined with the softer portions, is built on the ground, commonly on a slope, under the shelter of a tuft of grass. The eggs, five in number, are subject to great variation. They are gray or brown, freckled or blotched with a darker shade.

The rock pipit (*Anthus petrosus,*) nests sparingly in the

neighbourhood of Hoylake and at Hilbre. The nest is ordinarily in a bank or rock facing the sea, and is often inaccessible.

The sky lark (*Alauda arvensis,*) so abundant and so generally known, needs little comment. The nest, composed of grass lined with the softer portions, is placed upon the ground under the shelter of friendly herbage. Three to five is the number of eggs found in one nest. They are subject to singular and great variation. The standard is gray, freckled over with colour of a deeper tone.

The woodlark (*Alauda arborea,*) may nest, as it occasionally occurs here.

As its name implies, the common bunting (*Emberiza miliaria,*) is an abundant bird. Though resident in Britain, I have never seen it here in winter, but there is scarcely a field without it at other seasons. The song is harsh, and commenced early in spring. The nest, composed of grass lined with hair, is placed amongst rough herbage near the ground. One which came under my notice last spring, was without the hair lining, and was very similar to a lark's. It is at all times difficult to find, the more so because it is commonly in a corn-field or meadow. The eggs are pale drab, streaked and blotched with various darker shades. Four or five form the complement.

The black-headed bunting (*Emberiza schœniclus,*) an interesting partial migrant, is met with in this district sparingly in winter and plentifully at other seasons. For the most part, it affects sedgy ponds and marshy places, but is by no means restricted to them. Many may be met with on the Cheshire sandhills, where the nests are frequent in spring. The nest, composed of grasses lined with hair, is placed low amongst rough herbage, and sometimes on the ground. The eggs are variable, and five form the complement. They are pale drab, blotched and streaked with black.

The yellow bunting (*Emberiza citrinella,*) is an abundant resident and will be known to every one. In winter, this bird gregariously frequents farm-yards in company with sparrows and finches. The song is harsh. The nest, composed of coarse grasses lined with hair, is placed amongst rough herbage, and sometimes in a bush. The eggs are very variable, and three to five are found in one nest. The type is pinkish white, streaked and blotched with lilac and black.

The lively chaffinch (*Fringilla cœlebs,*) is a well-known and interesting resident. The females, and perhaps the young birds of both sexes, spend the winter in large flocks, frequenting stubbles, farm-yards, or other places where food and shelter are most readily obtained. Amongst these, old males are seldom seen; in fact, are not met with at all in the same proportion at this season. Many of the mature males probably migrate, and return here early in March, when the song is immediately commenced. On the approach of, and during rain in spring, the song is suspended, being replaced by an often-repeated plaintive chirp. The nest, composed of moss with more or less lichen, and lined with hair, is one of the most beautiful. It is neat, compact, and rather narrow, but varies in appearance according to situation and circumstances. Trees and bushes are equally chosen for the site. A curious, rather spreading aberration, composed almost entirely of moss, lined with hair, came under my notice last spring, and was a source of disappointment, as I had anticipated its being a nest of the more rare goldfinch. A second was lined with a profusion of feathers. The eggs are very variable, and are pale blue, suffused, spotted, and blotched with reddish brown. Five form the complement of all the Fringillidæ which nest here.

The sparrow (*Passer domesticus,*) needs no comment. Its beauty must not be judged by the smoked specimens found in town. The domed nest, composed of hay or straw, lined

with feathers, is a rather rude though not inelegant fabric. It is placed in ordinary situations in trees or ivy, in holes in trees, walls, spouts, &c., and sometimes in the old nest of a crow or magpie. The eggs are subject to very great variation. The type is white, spotted with gray.

The greenfinch (*Cocothraustes chloris,*) is resident, and is more abundant than formerly, owing perhaps to the increase of shrubberies, to which it is very partial. It is social in winter. The nest is composed of moss and twigs, lined with hair, and is placed in a tree or bush, often with no attempt at concealment. The eggs vary, and are white, spotted with reddish brown.

The elegant goldfinch (*Carduelis elegans,*) is scarce here. It is interesting to watch this lively, handsome bird, whilst feeding on the thistle seeds. Its adroitness, and variety of positions, rival those of the tits. I have several times seen the nest in a sycamore tree, near the extremity of a slender branch, where of course it could not be examined. The eggs are white or pale green, spotted with reddish brown and black.

The common linnet (*Linota cannabina,*) is another lively, handsome and common resident. In winter, large flocks frequent various pasture lands in search of seeds and seem very partial to those of the plantain. In haytime, great numbers with other finches resort to newly mown meadows. The nest, composed of moss and twigs lined with hair, is commonly placed amongst gorse. The eggs vary and are a link between those of the two preceeding species.

The lesser redpole (*Linota linaria,*) is also resident, but much less abundant than the preceding. In autumn and winter, flocks frequent birch and alder trees for the sake of the seeds. The nest is deeper and narrower than that of the linnet and is placed in an isolated bush or straggling branch of a hedge. It is composed of moss and fibres lined with the flock of sallow cathins. The eggs are pale bluish green, *freckled* and spotted with reddish brown.

Owing to shy and retiring habits, the bullfinch *(Pyrrhula vulgaris,)* is more frequently heard than seen. It frequents undisturbed woods and shrubberies, sometimes repairing, especially during winter and early spring to hedgerows and orchards in search of food. Gardeners dislike and shoot it on account of injury done to fruit trees. The buds of the cherry and other stone fruit trees are the greatest attraction. The ordinary note is a monosyllabic plaintive chirp and though said to be easily taught to whistle several tunes, the bullfinch has naturally no song. The nest, composed of twigs lined with fibres, is placed in a thick bush. The eggs are pale bluish green spotted with redish brown.

Birds vary, and their plumage differs at different seasons, so that too much pains cannot be taken in their identification. The restless activity of many species, and the shy, retiring habits of others, greatly increase the difficulty—to such an extent, in fact, that possession of the specimen is necessary. Their nests also vary in material and situation, sometimes approximating so nearly to those of another species, that a close inspection of the architect is again requisite. The eggs may decide though frequently they add to the dilemma. Those of the stonechat and whinchat, for instance, being alike, cannot be separated when mixed. Those of the blackbird, ring ouzel, missel thrush, fieldfare and redwing, range into one another so much through the medium of variation, that no positive line can be drawn between them. The same may be said of many others. On the other hand, many birds, nests, and eggs cannot be mistaken, and therefore need no further remarks.

There are still two opinions about the utility or otherwise of birds, but too much cannot be said in their favour. Game preservers destroy the hawk tribe, the crows, magpie and jay; the farmer protests against the sparrow, and the gardener shoots the bullfinch. Farmers and gardeners forget that their shot does

as much, if not more harm, than the birds they would destroy. What matter about the occasional partridge taken by a hawk, the egg taken by a crow, &c., or the wheat or cherry buds taken by the sparrow and bullfinch. Of course, a species ought to be checked where it occurs in excess, but wholesale and wanton destruction should be discountenanced. The good which birds do far exceeds the mischief. A friend of mine once shot the birds about his garden and in consequence had no fruit that year. Since then they have been protected. To give a notice of all the birds nesting in the district would make one paper too long; I shall therefore give the rest on a future occasion, following the classification of Yarrell.

ON MAGNETIC LIGHT.

By JOHN BAKER EDWARDS, Ph.D., F.C.S., V.P.

At the commencement of the present Session I exhibited to the Society a series of electrical experiments, to exemplify the intimate connexion existing between the phenomena of Voltaism, Magnetism, and Electricity, and the convertibility of the force thus elicited into Light, Heat, and Affinity. The present paper is intended to elucidate another view of the subject, viz.: the subjective relation of light and magnetic force. I would remind you in the first place, that the radiant force we derive from the sun is compound, consisting of light-rays, heat-rays, magnetic-rays, and actinic-rays.

Where the luminous rays preponderate, as at the poles, calorific rays are few. Where the calorific rays preponderate, as at the tropics, actinic rays are few. Where magnetic rays preponderate, as in the magnetic zone, luminous rays are few. If, therefore, we call the radiant force from the sun by the common name of light, we find very variable properties in the force at different positions on the earth's surface; if, however, we consider these as separate forces, we must attentively

consider the modifications which arise from their association with each other.

Beside emanations from the sun, we find certain terrestrial objects capable of yielding all these modifications of force. Whether originating from solar radiations or not, matter, as we find it, is indissolubly associated with force; and whether in our coal fires we elicit light and heat stored up through long ages, but originally derived from the radiance of a primeval sun, or whether we thereby simply convert a force of affinity into a force of radiance, the immediate result is the same, viz.: that we have in every particle of matter, simple or compound, stores of *force*, convertible under suitable conditions into heat-rays, light-rays, or magnetic-rays, or into attractions, chemical or physical. To the universality of this law and the theory of conservation of force derived therefrom, I have on a previous occasion directed your attention.

Electrical phenomena may be interpreted upon either of two hypotheses.

One regards the force as a fluid, capable of passing from point to point in space, and suffering resistance to a greater or less extent, by the particles of matter placed in the line of its progress. The other regards the force as an excitation of every particle of matter in the mass disturbed; each ultimate atom possessing for the moment N. and S. polarity, like the magnetic needle, and conveying a like disturbance to the atoms of every other mass capable of polarity, until a circuit of polar particles in contiguous molecules is obtained, and the completion of which circuit is essential to the continuance of the polarity which ceases when the circuit is broken.

The idea of the *transference* of a force is naturally entertained when the accumulated electrical discharge through air, is observed. The idea of *polarity* is exemplified by the lines observed in iron filings when under the attraction of a horseshoe magnet. It is however remarkable that the terminals of

a powerful battery of 250 cells have been approximated within $\frac{1}{100}$ of an inch of each other without any discharge taking place between the conductors. The polarity having been once established, however, by contact of the poles, the discharge continues, even when they are separated by a space of 4 or 5 inches.

The effect of electrical discharge in rarefied air was an early experiment. The body of light was increased in volume and the charcoal terminal of the positive pole being carried over and deposited upon the negative terminal, the conclusion was drawn that the luminous effect was chiefly due to the incandescence of the solid carbon during its passage from pole to pole; but this explanation can only partially account for the phenomenon, for I now show you examples of brilliant luminous discharges in rarefied gases, where no transposition or deposition of matter takes place, and the luminosity appears simply to depend upon the relations between the space traversed and the vibrations of the luminous wave.

The following effects are obtained by a Grove's battery, of 2 cells 4 X 5, an induction coil containing about 4 miles of secondary wire, and a condenser of 40 alternate sheets of tinfoil and gutta percha—

The spark through air at the terminals is about 3 inches long. During rarefaction of a column of air 3 feet in length, we observe first, faint scintillations of light striking the sides of the glass; on greater rarefaction a compact line of light of a brilliant rose colour traversing the jar; on further rarefaction this becomes enlarged to nearly the diameter of the jar, and is then intersected by horizontal lines, dividing the light into sections of a more or less spiral character. On the approach of a magnet this discharge is attracted towards the pole, in a degree depending upon the state of rarefaction, and the power of the battery.

When this column of light is made to fall over the pole of

an electro-magnet it is attracted in the direction of the magnetic curves, and rotates rapidly round the magnet, the direction of its motion being reversed when the polarity is altered, or the direction of the current changed.

A remarkable series of phenomena are exhibited by the Torricellian vacuum. When the mercury is made the negative terminal, and the tube is perpendicular, a luminous and equal glow is diffused throughout the tube; by reversing the current a remarkable blue tongue of light appears at the upper terminal, and banded stratifications appear of a plano-convex form, the convexity being towards the negative terminal. On restoring the mercury to the negative condition, the stratification disappears; but it is induced at the positive terminal on the approach of a magnet, while the blue tongue re-appears at the negative terminal. The same effects are produced on inclining the tube 30° or 40° towards the earth in any direction whatever, but again disappear when the position of the tube approaches the horizontal.

In this experiment the earth's attraction appears to be equivalent to magnetic attraction, in causing the rarefied vapour of the mercury to accumulate in these banded clouds, whenever the direction of the current is oblique to that of gravity.

When the tube is upright, gravity acts upon the vapour in a direction coincident with that of the current. When the tube is horizontal, the vapour is affected equally throughout its mass. Hence in these positions no stratifications appear.

Discharges of a similar character, through tubes charged with rarefied air, oxygen, hydrogen, nitrogen, and coal gas, exhibit stratification of a somewhat different character, giving the appearance of spirals of wire when the rarefaction is less perfect, and thin coin-like discs of light alternated with dark bands, when the rarefaction is very good.

This effect is well illustrated by carbonic acid vacua, which

a powerful battery of 250 cells have been approximated within $\frac{1}{100}$ of an inch of each other without any discharge taking place between the conductors. The polarity having been once established, however, by contact of the poles, the discharge continues, even when they are separated by a space of 4 or 5 inches.

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are furnished with a potash tube. After repeatedly heating this tube, the gas becomes gradually absorbed by the potash, and a very near approach to a true vacuum is obtained. Indeed, I have succeeded in repeating M. Gassiot's elegant experiment, in which the gas is so completely absorbed that the electrical discharge does not pass at all. When the potash tube is warmed however, vapour is thrown into the tube, and the luminous current then passes freely, and exhibits all the phenomena of more or less perfect rarefaction.

In this medium, the remarkable character of the light which surrounds the negative pole becomes more striking than in the elementary gases; but by careful observation the same peculiarity is obvious in every medium. The light issues from this pole in lines whose curves are identical with the magnetic curves at the pole of the magnet; and various experiments by M. Plücker of Bonn establish the relation of this light to magnetic force—hence he designates it "magnetic light."

In carbonic acid vacua this light assumes a brilliant blue colour, which contrasts beautifully with the general rose colour of the discharge. Modifications of the size and shape of the tubes give interesting phenomena, which seem to admit of no explanation, except on a mechanical theory, such as the polar and undulatory.

In a large tube, divided by a diaphragm with a small orifice, and well rarefied, the light at the negative pole is of an intensely blue colour, and fine magnetic radiance, while in the other hemisphere the light is of a pale rose colour, and intersected with luminous and dark bands. In a large tube with brass terminals, a small crack occurs in a portion of the glass insulator covering the joint with the platinum wire, a double surface thus becomes polar, and the result is, that when this faulty conductor is made negative, the appearance is that of a positive pole at each end of the tube, the magnetic light

being concealed beneath the fine stratifications arising at the fissure, and forming a new positive pole.

In a tube contracted in its centre to the size of thermometer tubing, a diffused luminosity fills the bulbs, while the contracted portion is filled with brilliant white light, which becomes yellow, and finally red when the potash tube is well heated. A similar tube filled with phosphoretted hydrogen, and exhausted, exhibits a magnificent cherry red in the contracted portion. A spiral contracted tube hermetically sealed within a wider tube, exhibits double stratification by induction.

A special effect of this light, is *fluorescence*, or "epipolic dispersion," which it exhibits in a remarkable degree. The same effect has been observed during remarkable displays of the *aurora borealis*, and although often considered as peculiar to chemical rays, is probably also characteristic of magnetic rays. When the glass tube through which the discharge passes contains oxide of iron, a fine green colour is seen within the surface of the glass. When the glass contains oxide of lead, this film is a delicate blue. When oxide of uranium is employed, it becomes a splendid grass green, which appears as a body-colour in the glass; and the effect is most remarkable when a solution of quinine or esculine is made to surround a white luminous discharge, the blue fluorescence then being very striking. This phenomenon affords another connecting link between magnetic and chemical Forces.

Electrolysis frequently result from the passage of the spark through compound gases. Phosphoretted hydrogen, sulphurous acid, and carburetted hydrogen, are examples; and as several tubes containing these gases have undergone great alteration since their preparation, these changes will be watched, and form the subject of a future communication to the society.

The conclusions to be drawn from the present experiments are;—That matter in a highly rarefied condition becomes

readily polarized, or magnetic; that the limits of vaporisation have never been reached by physical means, or by the air-pump, and that in the absence of gaseous matter, or vapour, electric force is not transmitted, and considered *as a motion* does not exist; that the closest relations are observed between the magnetic light and the actinic ray, especially in the phenomenon of fluorescence; and that the general tendency of the facts is to the conclusion that magnetism, light, heat, affinity, and gravitation, are only peculiar modes of motion of a common Force.

TENTH ORDINARY MEETING.

ROYAL INSTITUTION, 20th February, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Attention was drawn by Mr. HENRY DUCKWORTH to the Burdett-Coutts Geological Scholarships at Oxford.

Professor ARCHER exhibited a very rare bird which had been added to the Royal Institution collection during the last week—the *Tringoides rufescens*, (Gray.) It was very seldom seen in this neighbourhood, and he believed, had only been taken in the county once or twice. Respecting its capture he could give no information, as it had been purchased in the Liverpool market, in a string of snipes.

He also exhibited an ingenious instrument, called the Pneumatic Ventilator, Governor, and Fire-indicator, invented by Messrs. Taylor and Grimshaw. It was, in point of fact, an air thermometer, acting by the expansion or contraction of that fluid within a chamber of the cylinder, which constituted the chief portion of the apparatus. The air on expanding

produced a sufficient power on a piston rod either to ring a bell, or fire a cannon, when fire broke out upon the premises, and thus give timely alarum. It could also be advantageously applied in the laboratory, where chemical processes required to be conducted within a fixed range of temperature.

Mr. HIGGINSON pointed out the liability of vulcanised indiarubber, of which the diaphragm of the instrument was composed, to break or become friable when not constantly in use, which he apprehended would interfere with the efficiency of the apparatus.

Mr. GREGSON exhibited the following insects: *Bembidium prasinum*, from the river Petril, at Carlisle, taken in August; *Bembidium testaceum*, from G. Wailes, Esq., of Newcastle; *Bembidium stomoides*, from the river banks at Preston; and *Bembidium saxatile*, from the clay banks of the Mersey, near Garston. Also, *Lymnæum nigropiceum*, from Isle of Wight: and *Aëpys Robinii*, from Plymouth.

He also submitted a package of *Centeaurea tinctorea*, (the safflower of commerce,) so injured by the ravages of a small beetle, *Lasioderma testaceum*,* as to have reduced its commercial value from £10 to £7 per cwt. Having experimented with the article, he found that by exposing it to a tolerably high temperature, the *ova*, *larva*, *pupa*, and *imago* of the insect were destroyed, without injury to the safflower itself; but he found if submitted to a very high degree of heat, the dye would no longer give way to the fixed alkalies, consequently its commercial value, which entirely depended upon the beautiful *red* it produced, ceased; the yellow it gave out being better obtained from other sources.

The following papers were then read—

* Stephen's Manual of British Coleopt., 1839.

ON THE QUOTATION, "THE PROPER STUDY OF MANKIND IS MAN."

By the Rev. H. H. HIGGINS, M.A., President.

It is a well-established fact, that in the course of time many words change their meanings, and come to have significations very different to those which they formerly possessed. Thus in the English tongue certain words have become degraded, whilst others have much more honourable use now than in the days of our forefathers. This kind of transition is not limited to words, but affects also proverbs and short sentences or pithy sayings, which often speedily lose their original character and assume another. Thus, the saying, "Charity begins at home," at no very distant period expressed a wholly right and noble sentiment, but in our own days its frequent application in defence of niggardly and selfish propensities has given it a tone which is both harsh and coarse.

A fate somewhat similar has befallen the aphorism at the head of my paper. The truth it conveys is altogether imperishable, but the saying has degenerated into a cry, and its use in discussion rather elicits a smile than convinces the understanding—displays an animus rather than fairly illustrates the question at issue.

It is hardly necessary to insist upon the misappropriation of the passage when it is applied in disparagement of the study of natural science, although the original runs thus:

> Know, then, thyself, attempt not God to scan;
> The proper study of mankind is man;

for it may at once be admitted to contain within itself a truth worthy of attentive consideration, and my object in the following remarks will not be to set aside the quotation, but to

compare with other kinds of learning the study which is here assumed to be peculiarly proper for mankind.

The historian, the metaphysician, the politician, the poet, and the divine, each has an especial course to pursue in making mankind the object of his study; and these are but a few of the many whose avocations lead them to regard their fellow-creatures under aspects so various, that it is difficult to define the "study of man" in a way that shall be equally applicable to all. The most favourable case for illustration may probably be that of the historian: he at all events is bound to take a very broad and general view of humanity, and it belongs to him by his profession to record and give to the public the results of his observations. The historian must be eminent for sagacity and learning; to fulfil successfully the duties of his calling he must with wise discrimination select and in appropriate language present to his readers the most important the most interesting and the most instructive matters which have come before him in his study of mankind. The superior excellence of the study of man will, if anywhere, be found exhibited in the pages of history: yet what are the subjects which chiefly occupy these pages? Napoleon the Third said the history of the world is the history of armies; and it is at least equally true that the history of any country is the history of its wars. Battles, sieges, plots, insurrections, crimes, and their consequences, form to such an extent the materials of history that without them comparatively little of its substance would remain. It is not for an instant contended that the knowledge of these things is unimportant, but it is surely excusable not to be able to discern in the study of the quarrels of mankind any overwhelming or exclusive dignity; yet, forsooth, as some would interpret the saying concerning *the proper study*, the observer who has added a planet to our system must blush for the misuse of his time in the presence of one who has written a

treatise on the marriages of Henry VIII, or lectured on the domestic economy of the four Georges.

The fact may be, that the noblest qualities of mankind rarely find a niche in history: virtue in man, like peace in the affairs of a nation, offers little to the narrator, and so it comes to pass that the mass of history is as a dark background of stormy ever-changing evils setting off with enhanced brilliancy the lustre of a few fine characters.

Repudiating, however, all squeamishness at the rough facts of history, and taking as they come the sins and follies, the virtues and generosities, the triumphs and calamities of mankind, we find all these may be grouped under a single head in the category of mental exercitations—*they are all stimulants*—for warning or encouragement, arousing love or fear, admiration or hatred, all that has been done by man, or that has befallen man, acts by sympathy not only to instruct but to impel the mind.

The exercise of the pure unbiased intellect requires some other field than the study of man. It may be replied that it is quite possible for the intellect to decide with perfect impartiality in questions of human affairs, else how could juries deliver a true verdict, or judges equitably decide a case? I admit readily the possibility of subjecting the emotional to the intellectual. The question is whether the emotional is not called into exercise; and I believe in every such case, to a certain extent, it is. In a legal tribunal partiality or impartiality matters little; the case is decided according to certain rules of evidence, often solely against the feelings of the court.

In matters historical I doubt not the supreme authority of the intellect chastening directing subduing and with equal frequency enhancing and intensifying the natural sympathies of the mind, but never acting with perfect independence. He that could write the fate of Mary Queen of Scots or of the

French Revolution as he would work a sum in arithmetic is not a man to be envied, if such an individual ever existed. And if these are extreme cases, yet in all questions relating to human affairs sympathy will be enlisted on one side or on the other.

Hence we may discern how valuable is the study of natural science, not to speak of its objective results, as a means of mental culture. In its higher branches natural science affords scope for the most sublime contemplations. So arduous are the paths of thought in astronomy, geology, and chemistry, that master minds alone are able to follow even where others have gone before to lead the way; and it is equally true of natural history, that it trains the perceptive faculties to powers of observation surpassed only by that creative power which throughout nature man learns to recognise and observe. It is doubtful whether the study of mankind offers equal advantages for the education of the understanding, much less the course pursued by those who aspire to be called men of the world; for shrewdness capacity for intrigue astuteness and diplomatic skill are poor substitutes for the true philosophy of man.

At all events the other line of study has a claim altogether its own, for the philosophy of nature is the province where alone the intellect, the brightest daughter of the soul, claims perfect freedom; there the grave monitions of conscience are uncalled for; there those wayward sisters, the affections, need no looking after; there the pranks of that mental Ariel, imagination, no longer worry; but there, with truth for a guide, and the universe for a limit, intellect roams, "in maiden meditation, fancy free."

We may take other ground, and affirm the study of man itself to be in some measure dependent upon the study of natural science; for many amongst the most distinguished of mankind have gained their honours as interpreters of nature and her laws; and of these men how impoverished a con-

ception only can be formed at second hand! He who of himself knows nothing of the response of nature, when invoked by inductive science, can scarcely hope to appreciate our greatest philosophers, nor will any amount of the study of man alone enable him to understand the men who have devoted their lives and labours to the cause of natural science. Very much of poetry and of painting also must be unintelligible to any one who has not diligently sought acquaintance with nature. In short, he who seeks to exalt the study of mankind by limiting the proper sphere of man's study defeats his own intention.

We may indeed be asked to draw a comparison between the investigation of the thoughts and actions of mankind and the pursuit of natural history, and to decide whether it is not altogether more worthy of man's position in creation for him to bestow his attention upon his equals than upon things inferior to himself. But this way of putting the question is nothing better than a specious fallacy; for by a parity of reasoning, since there is One higher even than man, it must be still more worthy of him to fix his thoughts exclusively upon the Divine Being. The best reply may be found in the words of the Preacher: "To everything there is a season, and a time to every purpose under the heaven."

It has not been thought necessary to dwell upon the two most obvious reasons for the study of natural science, namely, the design of the Creator in giving man so glorious a field as nature for his study; and secondly, the influence which the results of scientific inquiry have had on the welfare and happiness of mankind; because arguments so weighty seemed ill adapted to meet the sort of ratiocination illustrated in the common misuse of the quotation, "The proper study of mankind is man."

It is, indeed, too true that there is much in the so-called study of man which sorely stands in need of anything to

recommend it, but to which, nevertheless, some are partial, finding a certain morbid gratification in overhauling heaps of moral refuse, to the great discomfort and disgust of all whose tastes are less depraved than their own.

Leaving, however, all such propensities out of consideration, it also seems to me that the general estimate of human character is too unfavourable. For, as soon as we become intimately acquainted with any one, we find in him much good which we are sure is unknown to others. The opposite result occurs, but is comparatively rare. Hence it follows that there is more undiscerned good than evil in mankind, or, which is the same thing, that our estimate of human character is below the reality.

These two circumstances, a taste for dwelling on the darker aspects of humanity, and the inconspicuous character of many virtues, do, no doubt, affect injuriously the study of mankind, which after all is incomparably the noblest and most necessary employment of the understanding. If it be an excellence in natural science to leave the intellect wholly free, it is a far higher excellence in the study of man to animate and constrain the soul to follow whatever is beautiful and good and true. It is because we feel that abstract conceptions are powerless, inefficient things that we personify what we most fear and hate, and also what we most desire and love. The excellency of the Christian faith itself lies not so much in the superiority of its moral lessons as in the mighty influence exerted on human sympathies by the incarnation, through which the contemplation of perfect goodness is forever bound up with the study of man. No position, then, can be more false than his who sets in competition the study which is designed to train the heart to all things great and good, and the study which is fitted to strengthen and develop the powers of the intellect. Far more justly it may be maintained, that neither can accomplish its high purpose without the assistance and *co-operation of the other.*

ON THE BASEMENT BED OF THE KEUPER FORMATION IN WIRRAL AND THE SOUTHWEST OF LANCASHIRE.

By GEORGE H. MORTON, F.G.S.

The Trias is so called from the threefold division of its rocks, in the typical district of Germany, where it is most fully developed. It is the upper half of the New Red Sandstone of the earlier English Geologists, and was constituted a separate system on account of its Flora and Fauna, presenting close analogies to Mesozoic types; while the lower part (now the Permian system) belongs to the Palæozoic period. Though on the continent there are three distinct divisions of the Trias—the Keuper, the Muschelkalk, and the Bunter—in the British Islands there are only two, the middle one being absent. Professor Sedgwick says, "That the absence of the Muschelkalk is a blot upon the escutcheon of English geology ;" and when we consider that it is a limestone series, replete with the remains of the prevailing forms of life that existed at the time of its formation, it certainly is a subject of regret that it is wanting.

Uninteresting as this neighbourhood has long been pronounced to be in a geological point of view, it at least affords very great facilities for an enquiry into the cause of this singular omission of the Muschelkalk. The Bunter formation beneath its zone, is well developed, and so also is the Keuper, which reposes directly upon it without any trace of the limestones of the central division. This omission may have arisen from three separate causes. The Muschelkalk may have thinned out at a distance from the area of its greatest develop-

ment; but this cause does not seem probable, on account of the similarity in lithological character of both the Keuper and Bunter formations in distant countries. Perhaps the conglomerates at the base of our Keuper sandstone, may be the representatives of the Muschelkalk, though the usual absence of lime even as a cementing medium, certainly would not lead to such a conclusion. Again, the Bunter formation may have been dry land during the deposition of the Muschelkalk in more southern and easterly regions. If such were the case, some evidence should surely be visible in our immediate locality. Whatever view we may take of this important subject, the minute examination of the base of the Keuper formation is the only place where we can expect to find data towards solving the question. This explanation conveys a precise idea of the object of the present paper.

Before proceeding to point out in detail the peculiarities of the Keuper, it is advisable to refer to the five subdivisions of the Trias. From the examination of my original line of section, taken from the river Dee to the rise of the coal measures east of Liverpool, all these sub-divisions can be coordinated, for in different parts of that line all can be observed under very favourable circumstances, and present the following order of sequence from the top downwards:—

Red Marl	100	feet.
Keuper Sandstone, or Waterstones ...	350	„
Upper Bunter	400	„
Conglomerate beds of the Bunter	300	„
Lower Bunter	400	„
Total	1550	„

In the maps of the Geological Survey the sub-divisions are coloured (excepting that the upper and lower Bunter are not separated,) and they are very useful in marking out the leading features of a district, though they must not be supposed to be absolutely correct, for local geologists are collecting from time

to time new data from numerous artificial excavations, tending to correct them. It is to be hoped that means will be taken by the officers of the survey, to investigate such additions and improvements as may be necessary to make the maps accurate guides to local geology. I have alluded to this subject because my own map differs from that of the Geological Survey containing Liverpool; but as my sections have received the sanction of the geologist, Edward Hull, Esq., F.G.S., who originally surveyed the district, I expect that the result of my observations will be adopted in a new edition of the map.

The numerous and important faults which traverse the district and determine the contour of the land, have all a north and south strike, or lie a few degrees to the westward. The average distance between them is rather under a mile. Occasionally there are small cross-faults running into the main-faults, but seldom, if ever, crossing them. The direction of both the principal and minor faults is precisely the same as those which intersect the Wigan coal strata, from which it may be assumed that the forces acted in the same direction which produced each series, and also that they were coeval in time. The fractures in the Trias were probably coincident with the upheaval of the strata, and occurred soon after its deposition and consolidation in the Liassic period.

When the fissures between the walls of the faults opened, they seem to have been immediately filled with sand from the sea above, and by fragments dislodged from the sides. Often a subsequent extension of the fracture allowed a further infiltration of debris, which has caused the flag-like character observed at the sides of many faults. If, as is very probable, the land was elevated above the sea level at the time the numerous faults originated, the lines of dislocation must have formed long open ravines, and the surface must have been rugged and uneven; such a supposition would satisfactorily account for the enormous denudation which has taken place.

The more powerful faults often throw the strata off their continuity to the extent of 700 feet, bringing rocks of various Triassic age into juxtaposition. The great fault throwing up the pebble beds of the Bunter along a line from the Dingle to Kirkdale, is a good example of one of the most important of them. A section through it can be partially examined in a quarry in Netherfield-road, where it is 20 yards wide and filled with a very hard compact sandstone of uncertain fracture. There are many slight dislocations and slips of the strata, which frequently produce those beautifully polished surfaces so common in the neighbourhood.

These slickensides usually cover the sides of the great faults, but are more perfect on the exterior of the rock between them. In such cases it is evident that the polished surfaces could not have been caused by the original disruption of the strata, but by slight movements afterwards—long after the faults had been filled with debris. A throw of the strata to a very small extent, acting under immense pressure, seems to have been sufficient to cause the phenomenon.

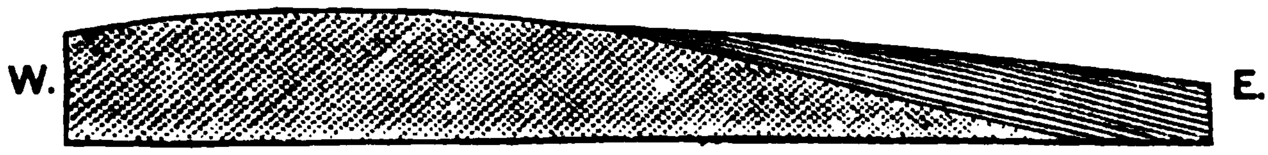
This opinion is confirmed by the occurrence of slickensides, at different angles in slides of the rock within the faults, and also by highly-polished surfaces in very slight slips which displace the strata only a foot or eighteen inches.

It is very probable that the coal measures might be reached by boring through some of the lower beds of the Bunter formation where they are brought to the surface by faults. Last year a boring in search of coal was made near Waterloo, in the series nearly one thousand feet higher than the Bunter sandstone nearer Liverpool. It is reported that some years ago similar unsuccessful attempts were made at Bidston, in the valley to the west, still higher in the Keuper series. Such investigations are sometimes of considerable scientific interest. If any individual desires to expend a few thousand pounds in order to obtain correct and indisputable geological sections,

it would be of more interest to science to commence with the lower Bunter formation, and at the same time more likely to yield some return for the expense incurred.

The Keuper formation in Wirral seems to admit of three clear and distinct subdivisions, viz.: the Red Marl, the Red or upper Keuper sandstone, and the Yellow or lower Keuper sandstone; the latter forms a coarse conglomerate towards its base. These upper and lower sandstones comprise the water-stones of my former paper upon the subject. The best localities for examining the red marl occur at Woodchurch—where the pseudomorphous crystals of chloride of sodium previously described were found—also along the brook between Irby and Arrow, and to the west of Greasby, and at Irby-hill. The following section, taken between the two last-named places, shows the red marl reposing upon beds of red sandstone, dipping to the east.

Section at Greasby.—Quarter of a Mile.



Keuper Red Sandstone, with Red Marl reposing upon it.

At Upton, and several other places the marl reposes upon thick beds of red sandstone. There seems to be no outcrop of any underlying strata in that locality, though it is very clearly shown that the red marl rests upon the red or upper Keuper sandstone.

The next section deserving particular attention is one through Oxton-hill. There is a road parallel, but a little to the north of the turnpike from Woodchurch to Oxton in which the soft red strata of the upper Bunter crop out to the west. These are probably succeeded by the variegated beds, for on ascending the hill the yellow beds of the same sub-division are seen to crop out from its base. Near the top, the conglomerate, or basement bed of Keuper sandstone is visible. This, the lowest stratum of the formation, is generally indi-

cated by the presence of a rocky ridge, and by large detached masses rolling down the adjacent slope, from the wearing away of the softer rocks beneath.

At the summit of the hill there are two large quarries exposing about 20 feet of the lower Keuper sandstone, the bottom of the bed being a very coarse white conglomerate, the upper part yellow, and terminated by four feet of marl. To the east of the quarries a soft yellow sandstone reposes conformably upon this bed of marl, and may be considered to represent the greater part of the lower subdivision.

Section at Oxton Hill.—One Mile.

Bunter Sandstone. Keuper Sandstone.

This yellow sandstone I have traced over the hill to Christ Church, where it appears to gradually sink under the red or upper Keuper sandstone of which the church is built. There is a new road to the west of that edifice, over the bare rock, where the junction of these yellow and red strata can now be examined. A little to the east a large quarry is open in the beds of red sandstone. They dip S.E. by E. at about 7°, are of coarse texture, light red shade, and contain occasional pebbles, the two visible beds being separated by a band of marl which thins out to the north. At the eastern end of the quarry three or four feet of marl overlie the red sandstone, no more rock being visible. Beyond, there is a deep valley containing a thick deposit of Boulder clay; beneath, there are very likely to be some of the lower beds of the red marl, if that shown at the quarry is not the base of it. The character of several bands of flagstone where it joins the rock seems to favour such an opinion.

At Bidston and Flaybrick the same order of succession

can be seen in relation to the lower Keuper, but the upper beds, if they are present, are all covered by drift. At Wallasey upon the yellow sandstone of the upper Bunter, the conglomerate beds repose ; these are succeeded by the yellow beds of the Keuper, but the upper subdivision of that formation, is lost by the great upthrow of the Bunter to the east.

At Storeton, the quarries are in the lower Keuper sandstone, but the basement bed is only visible at the bottom of the deeper excavations. It does not crop out to the west as shown in the Geological Survey map, but is thrown down both to the east and west, between beds of the upper Bunter sandstone. The northern quarry is rather higher than the others, and the white sandstone shows a tendency to change gradually to the yellow beds that are the next in the order of ascent. The per-oxide of iron which binds the grains of the lower Keuper sandstone together, varies considerably in its power of uniting them, quite independently of changes in colour. The white, yellow, brown, red and black colours assume many curious stains and markings, and the sandstone itself, even where the colour is uniform, after having been exposed to the atmosphere, has, by the removal of its softer parts, left curious projecting ridges, and spongiform surfaces. The sun-cracks in the marl bands are generally filled with sandstone adhering to the overlying stratum. The marl presents other indications of atmospheric phenomena, such as rain marks, running water, salt crystals, and other appearances, for which it is difficult to account.

The sandstone beneath the beds of clay is sometimes covered with ramous and branching ridges, which have been considered by some to be remains of fucoids. Such appearances are well known at Storeton. The ramifications are never seen to cross each other, a circumstance very much against an organic origin, while the plain upon which they rest does not seem to be ripple-marked. The surface appears

as though it had been acted upon by the atmosphere, but this cannot have been the case, for it is well authenticated that the ridges existed when the bed was first uncovered.

The Keuper sandstones, of which these Storeton beds are a good example, were named "Waterstones," by G. W. Ormerod, Esq., F.G.S., from the percolation of water along the beds of Marl dividing the strata. The cause of these plant-like forms may have originated from the denuding agency of the water continually passing over the sandstone upon which the marl rests, before the superincumbent stratum was removed. The water of the copious spring at Storeton, must formerly have flowed over the bed, where the supposed fucoidal marks exist. The only traces of organic remains consist of the footprints of Emydians and Batrachians.

On the Lancashire side of the Mersey, the Keuper formation is also developed. The lower sandstones can only be observed near Liverpool, in the neighbourhood of Harrington, Toxteth Park. The Bunter formation forms the rapidly-rising ground above the docks. The strata of which it is composed, co-ordinates with the variegated sandstone of the Red Noses, beyond New Brighton, and which no doubt exists beneath the yellow Bunter beds of Oxton. The latter seem to have been partially denuded on the Lancashire side of the river, for at Harrington the conglomerate beds of the Keuper rest directly upon the variegated Bunter beds; and the base line can be traced and examined over a considerable space, without any trace of the yellow sandstone until we approach the Mersey Iron and Steel Works, when they are faintly observed beneath the Keuper, upon which the wind-mill is built. It is very conclusive that about 50 feet of the upper Bunter had been removed by denudation before the overlying beds of the Keuper were deposited.

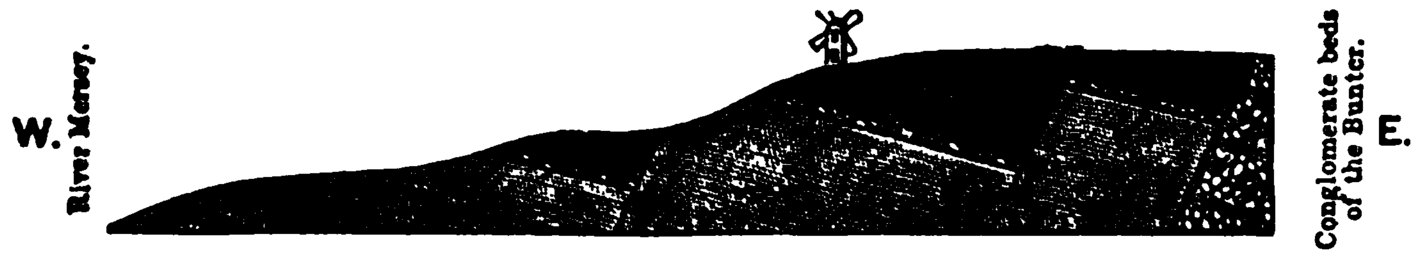
The base of the Keuper laid down in the Survey map takes

almost a straight line from the mill at Harrington, north to St. Augustine's Church, in Shaw Street. At the former place it is open for examination, and presents a coarse sandstone, with pebbles and nodules of marl, being very similar to the same bed at Oxton and Flaybrick, excepting that it is of a light red shade of colour, instead of being white or variegated like its Cheshire representatives. Elsewhere the base line of the Survey can only be seen in St. James's Cemetery, where blue and grey laminated fine-grained sandstones, with thin marl partings repose upon a considerable thickness of yellow sandstone. The following sections will show that it is probable that these yellow beds were mistaken for those of the Bunter which occur in Wirral, though even then the basement bed, so remarkably uniform in its character, could with difficulty be supposed to be identical with the blue and grey marl stones, so conspicuously displayed at the embankment on the eastern side of the cemetery. These sections will also prove that the yellow strata which strike through the town from north to south, always dipping to the east, belong to the lower Keuper sandstone. Mr. Hull has informed me that he was "very uncertain with regard to the section which is exposed to view in the cemetery," and that he took the bed of grey marl as the best he could find. We may therefore consider it as a provisional line, now that we find it to be incorrect.

Taking the base of the Keuper as displayed at Oxton and Flaybrick as a typical example, we find its exact representatives in each of the three following sections. The red conglomerate of Harrington no doubt co-ordinates exactly with the red and white one of Flaybrick, and also with the still lighter conglomerate of Oxton. The line of outcrop in Wirral is correctly laid down on the map of the Geological Survey, except at Storeton hill already alluded to.

An examination of the railway tunnels under the town has thrown important light upon this subject. The results enabled me to define the precise base of the Keuper at three different points otherwise inaccessible. The tunnel from Wapping to Edge Hill has laid open the upper Bunter and the lower Keuper sandstone, the conglomerate base with the yellow sandstones over it, interstratified with thick beds of red, blue, and grey laminated marl stones; but two faults have thrown up the strata to the east, (just as is shown in the Harrington section,) causing the upper part of the Keuper to have been denuded, or cut off by the greater up-throw of the Bunter formation to the east.

SECTION at HARRINGTON.—HALF A MILE.



Keuper Sandstone reposing on Upper Bunter.

I am much indebted to the Directors of the London and North-Western Railway Company, and to their late Secretary Henry Booth, Esq., for affording every facility to the most minute and lengthened examination of the strata shown in each tunnel. The white sandstone of the old quarry in Rathbone Street—now covered up—certainly belongs to the lower Keuper sandstone. The yellow strata of the cemetery repose upon it.

SECTION THROUGH WAPPING TUNNEL.—ONE MILE.

Keuper Sandstone reposing on Upper Bunter.

More than twenty years ago, Mr. Higginson discovered the footprints of Emydians—small land tortoises—in this

quarry, and though at that time we knew nothing of the superposition of the rocks in this neighbourhood, that observation is of the utmost importance now, being sufficient in itself to prove a considerable extension of the Keuper, westward of the line laid down in the map of the survey.

Near Kirkdale in the fields to the west of Scotland Road, the lower Keuper sandstone crops out upon the surface. The ends of the lowest beds form a steep escarpment towards the valley of the Mersey, and are obscured by Boulder clay. A very short distance to the east a fault throws up the yellow beds of the upper Bunter, which extend with a slight easterly dip, until they are cut off by the rise of the conglomerate beds of the Bunter formation at Everton. It is the same great fault which is represented as throwing up the latter in each of the sections.

SECTION at EVERTON.—THREE QUARTERS OF A MILE.

Drift. Keuper faulted against Upper Bunter.

The line of out-crop of the basement-bed of the Keuper formation in Wirral, and in the district about Liverpool, is drawn upon the map exhibited. Commencing north of Harrington, after having been twice thrown down by faults—one only of them being noted on the Survey map—it runs almost due north, under St. Michael's Church, west of St. George's Hall, by Limekiln Lane, and a ridge of rock to the west of Scotland Road, where it turns gradually round to the east, and is cut off by a fault, half-a-mile south of the prison. Between this fault and the great up-throw below Everton, there is a narrow space of upper Bunter, which probably

extends to St. Augustine's Church where the Keuper reposes upon it, as shown in the Geological Survey map. The Free Public Library and Museum is situated upon strata which coordinate exactly with the Storeton Hill sandstone.

The three sections across the town would alone be sufficient to authenticate the line I have laid down, but it is confirmed by many artificial openings that have been made at various times and places. Between Walton and Bootle there are two outliers of the lowest Keuper beds, covering the Bunter. They are represented on the Geological Survey map. South-east of Bootle a new road runs through an artificial cutting in the sandstone. The result of a partial examination of the strata about Waterloo and Crosby, shows that a similar disposition of the Keuper extends considerably to the north of Liverpool.

I have now enumerated all the deposits that can be referred to the formation in this locality, and traced the lines where the lowest or basement-bed crops out upon the surface. The Keuper has been removed by denudation from off all the other strata in the district, so that the space occupied by those rocks, and open for our examination, is rather contracted, though very accessible.

Having now disposed of the boundaries of the Keuper formation, where different to those published by the Geological Survey, it is necessary to review the results afforded by the combined sections in order to find if any particular reason can with safety be assigned for the absence of the Muschelkalk from the lithological nature of the upper Bunter, or the first formed beds of the Keuper in this district. If the line of junction between these two formations be examined, *the distinct separation of each is the most remarkable feature.* The upper Bunter beds consist of very soft, yellow, variegated and red sandstones, without marl partings, nodules, or pebbles;

they never show ripple marks, are often false bedded, and traversed by numerous ferruginous joints. The base of the Keuper, on the contrary, is always a conglomerate, or coarse sandstone, containing nodules and small fragments of marl, with numerous quartz pebbles, and is always of sufficient hardness to form a good building stone. The upper Bunter on the other hand is only used for the sake of the sand. It never occupies an elevated position, excepting when covered and protected by the hard sandstones of the Keuper. The surface of the formation is uneven and abraded. In Wirral, about 50 feet of the highest beds are yellow; but, on the Lancashire side of the Mersey, they have been denuded towards the south end of the town, though near Kirkdale they seem to be fully represented. In fact, all the observations made tend to show that the base of the Keuper formation rests upon the worn and eroded surface of the Bunter, which has been in the course of undergoing denudation up to the time of the deposition of the overlying formation. This indicates at least a suspension of deposits, or, perhaps, the existence of dry land during the time that the Muschelkalk was accumulating in other regions.

Mr. Hull, in a very interesting paper read before the Geological Society of London, and published in the Quarterly Journal for the present month,* brings forward facts tending to the same conclusion, as the result of his very comprehensive researches over the whole area of the formation in England. He states that a slight unconformity certainly exists between the Bunter and Keuper formations, and that there is a section near Ormskirk,† satisfactorily proving it at that place. The discovery of an unconformity so near Liverpool is, of course, very important, and cannot fail to tend towards the more correct elucidation of the geology of this

* February, 1860.
† Scarth Hill, and section on Railway south-east of Ormskirk.

neighbourhood. In consequence of the peculiar condition of the upper Bunter strata it is very difficult to make exact observations upon the subject; though time and close observation will very likely produce data proving a slight unconformity to exist at Flaybrick, where the extensive excavations offer great advantages to such an investigation.

If the Muschelkalk had thinned out, it is very probable that the junction of the Keuper and Bunter formations in this country would have been so gradual as not to have left a prominent line of separation, but that it would have been impossible to have known exactly where one formation ended and the other commenced. Although some geologists have been inclined to consider the wide-spread conglomerate base of the former as an equivalent to the Muschelkalk, the occurrence in Germany of sandstones with laminated marls and a conglomerate, seems so very like our own Keuper as not to favour any such conclusion, even taking the calareous cornstones into consideration which sometimes occur with the pebble beds at the base of the formation. The most reasonable conclusion to be drawn from a general examination of the lithological character of the rocks appertaining to the Keuper and Bunter formations in this neighbourhood is—that after the Bunter had been deposited an elevation of the land took place, and exposed the newly-formed strata to denudation, as a land surface for a long period, during which the limestones and dolomites of the Muschelkalk, with its beds of gypsum and rock-salt, were deposited in those regions that had not been elevated.

With the dawn of the Keuper a gradual and long continued subsidence commenced. The beds of pebbles were deposited, followed by thick strata of white and yellow sands uncovered by spring tides. Large quantities of coloured marl were drifted over the sands, frequently rolling into nodules, but often forming beds of considerable thickness, or mingling

with the sand produced beds of a slate or flag-like character. Upon the soft and yielding beds of clay were imprinted the footmarks of the reptiles that traversed those sandy wastes, perhaps millions of years ago. The surface dried and cracked, and where pools of water had evaporated, became covered with the crystals of chloride of sodium until covered up by the return of sedimentary matter.

Slow and long continued subsidences seem to have often operated through the long-drawn ages of geological periods. The latter part of the carboniferous system is a stupendous example of such a gradual subsidence, when vast and luxurious forests followed each other in succession beneath the waters, and were covered, one after the other, by argillaceous and arenaceous deposits. Such a slow subsidence is characteristic of the Keuper, both in England and on the Continent. Our knowledge of the formation ends with its vast tracts of saline marshes, uncovered at intervals, and extending along the eastern border of what is now called Wales.

ELEVENTH ORDINARY MEETING.

ROYAL INSTITUTION, 5th March, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. HIGGINSON exhibited two semi-circular magnets in form of a ring, and explained the properties as compared with those of the ordinary magnet of horse-shoe form.

Dr. COLLINGWOOD placed upon the table specimens of the nudibranch, *Eolis concinna,* found upon zoophites growing at the Egremont shore. (See page 32.) He also announced

liscovery of an additional local species, *Eolis exigua*, d in company with the others; and read a letter from Mr. r, confirming the facts, and also identifying the zoophite which these little creatures are found so abundantly at season as the true *Laomedea gelatinosa*.

r. Ihne exhibited a Burmese book, formed from the leaves le talipot palm.

le following Papers were then read—

ARTEFACTA ANTIQUISSIMA:

LOGY IN ITS RELATION TO PRIMEVAL MAN.

By HENRY DUCKWORTH, F.R.G.S., F.G.S.

discovery of works of human art in caverns and in icial deposits, associated with remains of animals o supposed to have become extinct before the intro- of man upon the earth, is a subject at present attracting ll amount of attention in the scientific world.

le following notes I have endeavoured to draw up an of the principal facts relating to this question, and I y may prove of service to those who have had no ities of collecting the scattered evidence themselves.

leven years since M. Boucher de Perthes, the well- chæologist of Abbeville, published the first part of ited "Antiquités Celtiques et Antédiluviennes."* book, amongst other remarkable statements, he he had discovered in beds of undisturbed diluvial e valley of the Somme, flint instruments—evidently he hand of man—associated with remains of the *Elephas primigenius*,) and other extinct animals.

(imprimé en 1847, publié en 1849.)

This singular announcement, strange to say, hardly excited any attention at the time. Men of science ridiculed the very idea, and were incredulous. Such treatment might perhaps have cooled the ardour of any other man than M. de Perthes; but he only carried on his researches with redoubled energy, and after a lapse of eight years, the second part of his work appeared, in which he boldly re-asserted his former opinions.

In the following year, (1858,) facts of a somewhat kindred nature were elucidated at Brixham, in Devonshire. A cavern abounding in fossil remains having been discovered there, the Royal Society voted a grant for its examination, and the exploration was entrusted to Dr. Falconer and Mr. Pengelly.

From the preliminary reports it appears that the principal remains brought to light so far are those of Rhinoceros tichorrhinus, Bos, Equus, Cervus tarandus, Ursus spelæus, and Hyæna—and curiously enough,—a great number of flint knives and arrow heads, evidently of human manufacture, were discovered indiscriminately commingled with them. One in particular was found immediately beneath a fine antler of a reindeer and a bone of the cave bear, which were imbedded in the superficial stalagmite in the middle of the cave.*

This remarkable revelation naturally reminded Dr. Falconer of M. de Perthes' discoveries, and having proceeded to Abbeville to inspect that gentleman's magnificent collection of worked flints, he returned thoroughly convinced of their genuineness, and at his instigation Mr. Prestwich was persuaded to cross the channel and to examine the gravel beds in the valley of the Somme. Mr. Prestwich who informs us that he undertook the inquiry full of doubt,† went towards the end of April last year to Amiens, where he found the gravel-beds of St. Acheul capping a low chalk-hill a mile S.E.

* Abstract Proceedings Geol. Soc., 22nd June, 1859.

† Proceedings of the Royal Society, 26th May, 1859.

of the city, about 100 feet above the level of the Somme, and not commanded by any higher ground.

The beds, as determined by him, consisted of—

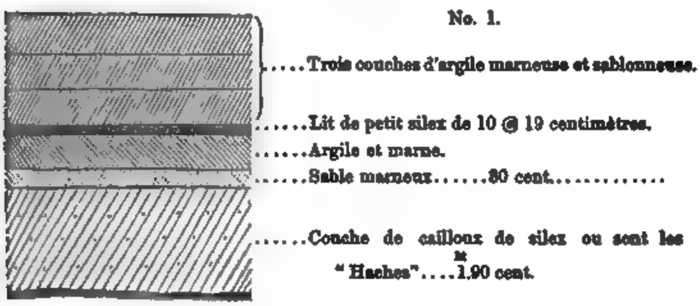
1st.—Brown brick-earth (with old tombs and coins,) 10 to 15 feet.

2nd.—White marl containing recent land and fresh-water shells, 2 to 8 feet.

3rd.—Coarse sub-angular gravel in which are found bones of *elephas*, *equus*, *bos* and *cervus*, and the flint instruments, ("Langues de chats" of the workmen,) 6 to 12 feet.

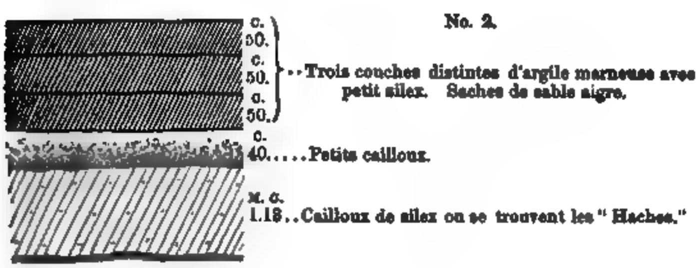
Mons. Pinsard, of Amiens, with whom I have lately been in correspondence, has kindly sent me drawings of sections of these beds, and his classification, as will be seen from the annexed cuts is rather more elaborate than Mr. Prestwich's.

No. 1.



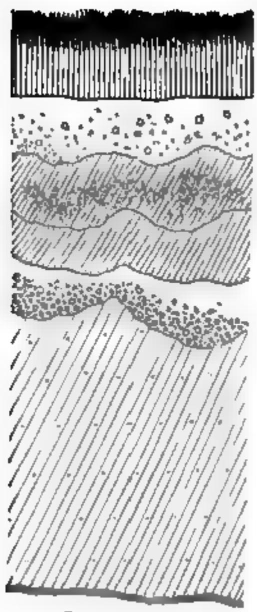
Craie. (Chalk.)

No. 2.



Craie. (Chalk.)

No. 8.



Craie. (Chalk)

The irregularity in the stratification of these beds is a point on which M. Pinsard particularly dwells, and I will here state what he says respecting it in a letter addressed to me—

"La stratification du diluvium de St. Acheul est très irrégu- "lière, et les coupes que je vous donne aujourd'hui ne sont "que des moyennes."

"Lorsque les ouvriers ont avancé les tranchées de quelques "mètres, la hauteur de gravier varie très sensiblement; la "hauteur du banc de gravier dans lequel se trouvent les "Haches varie de 2 à 4 mètres, mais la hauteur moyenne est "de 2 mètres 90 centimètres environ."

"Les couches supèrieures indiquent plusieurs dépôts, ces "sont des argiles, des glaises, et des bancs de petits cailloux, "(aussi des bancs faibles de Sable Aigre.) les couches d'argile

"qui sont voisines des cailloux sont très marneuses et c'est "dans ces couches que se trouvent beaucoup de coquilles "décrites par Mr. Prestwich."

"Ou trouve tous les jours de Haches, très souvent des "dents de cheval et rarement des dents d'elephants; ces "objets sont dans les couches de gravier posée sur la craie.

"Les dépôts de St. Acheul, sont curieux à cause de leur "irregularité. Si on mettait le gravier à peu on n' aurait pas "une surface ondulée mais une surface composée de petits "cones à peu près semblables aux dunes de la Yeu près St. "Valery-en-Mer."

"Je n' ai pas remarqué que les couches inclinent vers la "vallée de Somme plutôt q' autrement."

"L' irrégularité existe partout; les couches supérieures "seulement sont plaines."

"Du sol de la craie audessus de la terre végétale, on peut "toujours compter 6 à 8 dépôts et quelquefois 10. Vous le "voyez l' irrégularité est grande et les couches donnent des "époques différentes.

"Les '*Haches*' se trouvent exclusivement dans les couches "qui reposent sur la craie."*

Mr. Prestwich on his first visit obtained several specimens of worked flints from the quarrymen, but could not find any himself. Revisiting the pits, however, shortly afterwards with Mr. Evans, he was shown one which had been left "*in situ*" for his inspection. It was 17 feet from the surface, in undisturbed ground. Photographic views of the section were taken by

* And Mons. Buteux, in his memoir "La Géologie du départment de la Somme," writes thus.—"Ainsi il est bien établi, et je le répète: les objets que "nous allons décrire ne se trouvent ni dans le limon argilo-sableux ou terre à "briques qui forme la couche supérieure, ni dans les lits intermédiaires d' argile "plus ou moins pure, de sables et de petits cailloux. * * * * * Mais "ils se rencontrent exclusivement dans la véritable diluvium c' est-a-dire dans le "dépôt qui renferme les restes des espèces animales de l' époque qui a précédé "immédiatement le cataclysme par lequel elles ont été détruites. Il ne peut y "avoir aucun doute a cet égard."

Quoted in "*Antiquités Celtiques et Antédiluvienne,*" vol ii, p. 9.

Mons. Faure of Amiens, and having obtained copies from that gentleman, I am glad to have an opportunity of exhibiting them to this society.

Later on in the year Mr. Flower obtained a very perfect specimen of a flint instrument from these beds himself* ; and about the same time Mons. Gaudry (Membre de l' Institut,) examined a fresh section, with the most satisfactory results, for no fewer than nine implements were discovered associated with remains of rhinoceros, hippopotamus and mammoth.†

Besides visiting Amiens, Mr. Prestwich went to Abbeville, Moulin-Quignon, St. Gilles and Menchecourt, at all of which places he appears to have found the deposits occurring much in the same order as those of St. Acheul.

Menchecourt is especially interesting on account of the admixture of marine and freshwater shells in one of its beds, and the great quantity of Mammalian remains found along with "Haches" in the lower stratum of sub-angular gravel.‡

The bones in question are those of Elephas primigenius, Rhinoceros tichorrhinus, Cervus Somonensis, Cervus tarandus-priscus, Ursus spelæus, Hyæna spelæa, Bos primigenius, Equus adamaticus and a Felis.

Mr. Prestwich examined M. Boucher de Perthes' collection

* Abstract of Proceedings Geol. Soc., No. 36, 22nd June, 1859. *Times*, 18th Nov. 1859.

† "*L' Institut*," 5th Oct. 1859.

‡ A section examined by Mr. Prestwich consisted of—1. A mass of brown sandy clay with angular fragments of flints and chalk rubble. No organic remains. Base very irregular and indented into No. 2; average thickness 2 to 12 feet. 2. A light coloured sandy clay, ("sable gras" of the workmen,) analogous to the *Loess*, containing land shells, pupa, helix, and clausilia of recent species. Flint axes and Mammalian remains are said to occur occasionally in this bed; average thickness 8 to 25 feet. 3. White sand ("sable aigre") with 1 to 2 feet of sub-angular flint gravel at base. This bed abounds in land and freshwater shells of recent species of the genera helix, succinea, cyclas, pisidium, valvata, bithynia, and planorbis, together with the marine Buccinum undatum, Cardium edule, Tellina solidula, and Purpura lapillus. Mr. P. also found the Cyrena consobrina, and Littorina rudis. With them are associated numerous Mammalian remains and it is said flint implements; average thickness 2 to 6 feet. 4. Light coloured sandy marl, in places very hard with helix, zonites, succinea, and pupa; not traversed.

at Abbeville, and appears to have been much astonished at its beauty and extent. The opportunity was a favourable one for comparison, and he did not fail to profit by it, for in speaking of the different appearances of flint instruments from various localities in the Somme valley, he makes the following important observations:—

"In looking over the large series of flint implements in M. de Perthes' collection, it cannot fail to strike the most casual observer that those from Menchecourt are almost always white and bright, whilst those from Moulin-Quignon have a dull yellow and brown surface; and it may be noticed that whenever (as is often the case,) any of the matrix adheres to the flint it is invariably of the same nature, texture and colour as that of the respective beds themselves."

"In the same way at St. Acheul where there are beds of white and others of ochreous gravel, the flint implements exhibit corresponding variations in colour and adhering matrix; added to which as the white gravel contains chalk *débris*, there are portions of the gravel in which the flints are more or less coated with a film of carbonate of lime; and so it is with the flint implements which occur in those portions of the gravel."

From such plain facts as these, he justly infers a contemporaneous deposition of the instruments and the gravel in which they are imbedded. It is well known that flints become deeply discoloured when in ochreous deposits, whitened and opaque in argillaceous matter, encrusted with carbonate of lime when imbedded in chalk; and here we find the "Haches" exactly in the same condition in this respect as the rough unworked flints which surround them—"a constituent part of the gravel" in fact, as Mr. Prestwich observes. There seems to be no doubt as to the age of the drift deposits in question; and Mr. Prestwich identifies them with the gravel of East Croydon, Wandsworth Common, and other places in the neighbourhood of London.

The predominant form of "Haches" found at Amiens varies very materially from that of the Abbeville specimens.

The former are generally long and pointed at one end, and appear to have been primeval spear heads.

Those from Abbeville, on the contrary, are oval and chipped to a comparatively fine edge all round. Mr. Evans seems to think they may have been used as sling-stones or hatchets.

The accompanying sketches, however, will convey a better notion of the two types than any description. (See plate V.)

Before leaving this part of my subject, I would allude to the very able address delivered by Sir Charles Lyell, at the last meeting of the British Association, and which related almost entirely to the question now before us.

Having visited Amiens and Abbeville himself, and examined the drift beds in the valley of the Somme his words necessarily carry great weight with them.

The conclusions which he arrived at respecting the nature and age of the deposits in which the flint implements are found, may be gathered from the important passage quoted below.*

* "But while I have thus failed to obtain satisfactory evidence in favour of the remote origin assigned to the human fossils of Le Puy, I am fully prepared to corroborate the conclusions which have been recently laid before the Royal Society, by Mr. Prestwich, in regard to the age of flint implements associated, in undisturbed gravel in the north of France, with the bones of Elephants at Abbeville and Amiens. These were first noticed at Abbeville, and their true geological position assigned to them by M. Boucher de Perthes in 1849, in his "Antiquités Celtiques," while those of Amiens were afterwards described in 1855, by the late Dr. Rigollot. For a clear statement of the facts, I may refer you to the abstract of Mr. Prestwich's Memoir in the Proceedings of the Royal Society, for 1859, and I have only to add that I have myself obtained abundance of flint implements (some of which are laid upon the table,) during a short visit to Amiens and Abbeville. Two of the worked flints of Amiens were discovered in the gravel-pits of St. Acheul, one at the depth of ten, and the other of seventeen feet below the surface, at the time of my visit; and M. Georges Pouchet, of Rouen, author of a work on the "Traces of Man," who has since visited the spot, has extracted with his own hands one of these implements, as Messrs. Prestwich and Flower had done before him. The stratified gravel in which these rudely-finished instruments are buried, resting immediately on the chalk, belongs to the Post-Pliocene period, all the freshwater and land shells which accompany them being of existing species. The great number of the fossil instruments which have been likened to hatchets, spear-heads and wedges, is truly wonderful.

It is worthy of note, that long before M. Boucher de Perthes dreamed of his wonderful discoveries in the Valley of the Somme,* flint implements, very similar in form to the "Haches" from Amiens, were found and described in England. It appears that so far back as 1797,† a Mr. John Frere published a memoir, giving an account of the discovery of numerous flint implements in a bed of gravel, eleven feet from the surface, at Hoxne, in Suffolk.

In this same bed of gravel (which is stated to have been covered with sand and brick earth) were also found bones of

More than a thousand of them have already been met with in the last ten years, in the valley of the Somme, in an area fifteen miles in length."

"I infer that a tribe of savages, to whom the use of iron was unknown, made a long sojourn in this region; and I am reminded of a large Indian mound which I saw in St. Simonds Island, in Georgia; a mound ten acres in area, and having an average height of five feet, chiefly composed of cast away oyster shells, throughout which arrow heads, stone axes, and Indian pottery are dispersed. If the neighbouring river, the Alatamaha, or the sea, which is at hand, should invade, sweep away, and stratify the contents of this mound, it might produce a very analogous accumulation of human implements, unmixed perhaps, with human bones."

"Although the accompanying shells are of living species, I believe the antiquity of the Abbeville and Amiens flint instruments to be great indeed, if compared to the times of history or tradition."

"I consider the gravel to be of fluviatile origin, but I could detetct nothing in the structure of its several parts indicating cataclysmal action; nothing that might not be due to such river-floods as we have witnessed in Scotland during the last half century. It must have required a long period for the wearing down of the chalk which supplied the broken flints for the formation of so much gravel at various heights, sometimes one hundred feet above the present level of the Somme; for the deposition of fine sediment, including entire shells, both terrestrial and acquatic; and also for the denudation which the entire mass of stratified drift has undergone, portions having been swept away, so that what remains of it often terminates abruptly in old river cliffs, besides being covered by a newer unstratified drift."

"To explain these changes I should infer considerable oscillations in the level of land in that part of France—slow movements of upheaval and subsidence, deranging, but not wholly displacing the course of the ancient rivers."

"Lastly, the disappearance of the Elephant, Rhinoceros, and other genera of quadrupeds now foreign to Europe, implies in like manner, a vast lapse of ages separating the era in which the fossil implements were formed, and that of the invasion of Gaul by the Romans."

* J'avais entrevu depuis longtemps cette race antédiluvienne et pendant bien des années anticipé sur la joie que j'eprouverais lorsque dans ces bancs que la géologie a si souvent déclarés déserts et antérieurs à l'homme, je trouverais enfin la preuve de l'existence de cet homme, ou à défaut de ses os, la trace de ses œuvres.—"*Antiquités Celtiqes et Antédiluviennes*," vol. ii. p. 8.

† Archæologia, vol. xiii., 1860.

some unknown animal, since presumed to have been those of the mammoth. Fully convinced of the artificial character of the flints, Mr. Frere regarded them as war implements "fabricated and used by a people who had not the use of metals"—and owing to the situation in which they were found, he was almost tempted to refer them "to a very remote period indeed—even beyond that of the present world."

Geology had scarcely become a science, it must be remembered, when these remarkable words were written.* Mr. Prestwich, shortly after his return from France, visited this interesting locality, but did not succeed in finding any implements himself;—one of two specimens, said to have been dug out of the brick earth deposit during the previous winter, was, however, shown to him by the workmen.†

During his visit to Italy, at the commencement of last year, Dr. Falconer made several important discoveries in the ossiferous caverns in the hippurite limestone, between Palermo and Trapani in Sicily; and the examination of the Grotta di Maccagnone, in particular, yielded most extraordinary results.

The cave in question, which lies about a mile to the west of Carini, is situated on the north-east side of Monte Lungo, near its base, about a mile and a half from the sea.

In the bone breccia below the entrance of the cavern, remains of hippopotamus were met with in great abundance; and in the upper deposit of humus inside, were found bones of Elephas antiquus,‡ horns of two extinct species of cervus, besides bones of other ruminants. Of the lower deposits,

* I may here mention, *en passant*, that there is in the British Museum a flint implement, stated to have been found, together with an elephant's tooth, opposite Black Mary's, near Gray's Inn Lane in London. It originally formed part of the Sloane collection, and therefore must have been discovered some time anterior to 1750.

† Proceedings of Royal Society, 26th May, 1859.

‡ As yet no remains of E. primigenius have been discovered here, or in any of the Sicilian caves.

the one known commonly as "ceneri impastate" (concrete of ashes) was found to contain remains of a felis of the same size as F. spelæa, a large ursus, and several small ruminants.

But the extraordinary feature about the cave—which before proceeding further, I should state, is encrusted with stalagmite—is this: at a spot on the roof, where a large mass of breccia was observed, denuded partly of the stalagmitic covering, Dr. Falconer found teeth of ruminants and equus, shells of several species of helix, bits of carbon, and a vast abundance of flint and agate knives of human manufacture.*

At other places, and wherever he had the calcareous coating removed, he found similar remains; and at one spot, on breaking the stalagmite, a thick calcareo-ochreous layer containing numerous coprolites of a large hyæna, was found against the roof.

Dr. Falconer is of opinion that the knives, "the majority of which present definite forms—namely, long, narrow, and thin"— . . . . "closely resemble, in every detail of form, obsidian knives from Mexico, and flint-knives from Stonehenge, Arabia, and elsewhere, and that they appear to have been formed by the dislamination, as films, of the long angles of prismatic blocks of stone. These fragments occur intimately intermixed with the bone splinters, shells, &c., in the roof-breccia, in very considerable abundance; amorphous fragments of flint are comparatively rare, and no pebbles or blocks occur within or without the case. But similar reddish flint or chert is found in the hippurite limestone near Termini."†

And now, after reviewing carefully the whole of the evidence adduced here, it may fairly be asked—Taking for granted that the flint implements, which have been found so

* Abstract Proceedings of the Geol. Soc. No. 32, 4th May, 1859.

† Abstract Proceedings Geol. Soc. No. 36, 22nd June, 1859.

plentifully in the Valley of the Somme and elsewhere, owe their present forms to human agency,* how comes it to pass that not a single bone of the men who fashioned and used them has as yet been discovered? To such an enquiry, M. de Perthes replies: "Ayez patience; avant Cuvier, vous ignoriez complètement que la butte de Montmartre recélât des milliers de quadrupèdes de l' époque dont il s' agit.

"Si l' on vous eut dit qu' ils y étaient et surtout qu'ils représentaient des espèces n'existant plus sur la terre, vous auriez refusé de le croire. C'est que vous feriez encore si l'on vous annonçait qu'on vient de rencontrer un amas de restes humains, et vous ajouteriez que cette trouvaille est impossible.

"Or, en ceci vous vous tromperiez, car ce qui n'est pas vrai aujourd'hui le sera demain, et si ce n'est pas à Paris ou en France qu'on trouve cet ossuaire humain, ce sera ailleurs.

"Oui, cette découverte doit infailliblement avoi lieu; il suffit, pour cela, d'une fouille heureuse, du retrait d'un lac on d'une baie, de l'éboulement, d'une montagne, &c.

"Alons ce ne sera pas un squelette isolé, c'en sera des milliers, parce qu'il est certain qu'antérieurement à la catastrophe diluvienne et peut être même à l'époque on elle arriva, les hommes étaient nombreux sur cette terre, et la preuve, c'est le nombre de leurs œuvres; par ce qui reste de ces monuments de pierre de ces haches, de ces outils en silex, on peut juger ce qu'il y en avait."†

But are we sure that human remains have not already been discovered, associated with bones of the mammoth, tichorrhine rhinoceros, and other extinct animals, in undisturbed deposits?

A little pamphlet, written in 1857, by Herr Robert Eisel,

* Mr. Wright, the Antiquary, and Dr. Ogden both doubt the artificial character of their objects: the former ascribing their peculiar forms to "violent and continued gyratory motion in water;" the latter, to chemical agency.—*Vide Athenæum*, Nos. 1651 and 1671.

† "Antiquités Celtiques et Antédiluviennes," avant propos. vol. ii, p. 13.

of Gera in Saxony, clearly proves, I think, that they have.*

It appears that in the gypsum quarries in the neighbourhood of Köstritz bones of Elephas primigenius, Rhinoceros tichorrhinus, Ursus spelæus, Bos primigenius, &c., have been discovered, intermixed with undoubted remains of man, in beds of clay covered with *débris* from the surrounding mountains. From the angular form of the fragments composing these *débris*, it may be inferred that they were not exposed to protracted aqeous action, but were deposited, soon after they were torn from their parent masses, in the crevices in which we find them at the present day.

This Southern diluvium must not be confounded with the Northern drift, which contains large rounded boulders of Norwegian granite and Galerites vulgaris, from the chalk of the north,—for it consists of an irregular deposit such as any sudden inundation in a mountainous region is apt to sweep along before and leave behind it.

It is supposed that the upper basin of the river Elster was formerly a lake, whose banks were inhabited by man† and by

* Zeitschrift für die Gesammten Naturwissenschaften, Halle-ü-Saale. Sept. 1857. No. ix.

Zur Umgebung von Gera. Ein Beitrag zur Kenntniss der dasigen quaternären Gebilde, von Robert Eisel.

I acknowledge here, with much gratitude, the kind assistance afforded me by Dr. F. Bialloblotzky of Göttingen, who procured a copy of R. Eisel's memoir, and made an admirable digest of it for me.

† The manner of life of this primeval race may perhaps not have been unlike that of the amphibious inhabitants of Lake Prasias, described by Herodotus. "Platforms supported upon tall piles‡ stand in the middle of the lake, which are approached from the land by a single narrow bridge. At the first the piles which bear up the platforms were fixed in their places by the whole body of the citizens, but since that time the custom which has prevailed about fixing them is this:—They are brought from a hill called Orbêlus, and every man drives in three for each wife that he marries. Now the men have all many wives apiece, and this is the way in which they live. Each has his own hut, wherein he dwells, upon one of the platforms, and each has also a trap door giving access to the lake beneath; and their wont is to tie their baby children by the foot with a string, to save them from rolling into the water. They feed their horses and their other beasts upon

‡ Robt. Eisel mentions that a semi-petrified trunk of an oak tree which evidently had been prepared by the hand of man for use, as it bore on its surface indubitable marks of the axe by which its work had been commenced, was found at Zwötzen, embedded in clay and boulders, twelve feet below the surface.

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That gigantic elk, Megaceros Hibernicus, has been found abundantly in the peat bogs of Ireland and the Isle of Man, also in Lancashire* along with remains of Hippopotamus major. Bos longifrons, though now extinct, we know for certain was co-existent with the earliest human inhabitants of these isles.

At a time like the present when a disposition to rush into extreme views respecting the antiquity of our race is so constantly manifested amongst us, it is well to bear in mind such facts as these, for I cannot help thinking they counteract in some measure the revolutionizing tendency of the evidence we have been principally considering here. The whole question however, it appears to me, is in such a peculiarly delicate position at present, that to attempt to arrive at any definite conclusions respecting it, is well nigh impossible. The wiser course by far is to exercise that habit of mind which a reviewer of Mr. Darwin's work on the "Origin of Species" has recommended to all students of the hypothesis set forth there,†—the "thätige skepsis" of Goethe—doubt which so loves truth that it neither dares rest in doubting, nor extinguish itself by unjustified belief.‡

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ON THE HEPATICS AND LICHENS OF THE NEIGHBOURHOOD OF LIVERPOOL.

BY FREDERICK P. MARRAT.

(See Appendix.)

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It was communicated from the Council that they deemed it desirable to mark their appreciation of Mr. GRINDON'S *Flora of Manchester*, by presenting to the author through the President of the Medical School in that city, a bound copy of the monographs on the local Flora of this district, extracted from the Proceedings of the Society; and a Sub-Committee was appointed to carry out this recommendation, consisting of the Rev. H. H. Higgins, M.A., President, D. P. Thomson, M.D., Hon. Secretary, and C. Collingwood, M.B., Lecturer on Botany.

The CHAIRMAN exhibited a copy of a work lately added to the Free Public Library—a *fac-simile* of "The Game of Chesse, by William Caxton," reproduced from a copy in the British Museum, printed in black letter, with many curious engravings. He observed that it was the second book ever printed in England, and was executed by Caxton in 1474. It was a remarkably interesting work, detailing the origin of the game of chess, which it attributed to Evil Merodach, King of Babylon. He detailed the peculiarity of the pawns and other features of the game as played by the ancients, contrasting them with those obtaining at the present day.

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the district of Liverpool. He also exhibited two young living alligators, sufficiently small to be kept in an ordinary aquarium.

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ON HOMOMORPHISM; OR, ORGANIC REPRESENTATIVE FORM.

BY C. COLLINGWOOD, M.B., F.L.S., &c.

BY Homomorphism is meant the recurrence of certain external forms in various departments of Nature, more or less widely separated by internal structure; so that at the outset, it is necessary to divest the mind of the idea that it partakes in any way of the character of homology.

By Homology, indeed, is distinctly understood a structural affinity, uniting, as it were in a common bond, the same organ, under whatever form it may appear, or whatever function it may assume. The limbs, for example, of quadrupeds, the wings of birds, and the fins of fishes, are thus structurally

united, and although taking very different *forms*, are strictly homologous one of the other. But the wing of a butterfly, though bearing a general analogical resemblance to that of a bird, has yet no community of structure with it; nor has the wing of a bat any stronger claim to be considered homologous with the wing of a true bird. The wings of a bat, or a butterfly, are *homomorphous* with the wings of a bird; and indeed perform the same function;—so far, therefore, they may be regarded as *analogues* of those organs. But it must also be understood that homomorphism does not necessarily imply analogy, in the proper sense of that term; for by analogy is understood, as distinguished from homology, an agreement of fuuction, where there is no community of structure, as just instanced; whereas homomorphism, while it expresses, primâ facie, an *absence* of agreement in structure, or homology, may, or may not, be accompanied by similarity of function, though the want of such functional agreement is the rule, and its presence an accidental exception.

From this it will readily appear that the study of homomorphism cannot be expected to be so prolific of important results as the study of homologies, inasmuch as these latter are believed to be the bonds of connection which unite forms apparently widely separated, and which throw light upon the true affinities of obscurely constituted organisms. And herein probably lies the reason why homomorphism has attracted so little attention from naturalists. I am not aware of any essay (though such there may be) upon this curious subject, which either collects and compares the various examples with which Nature abounds,—or, still less, which attempts to treat it upon such a basis as that on which all natural science should be treated. It appears indeed to be barely referred to here and there in the writings of zoologists, as something striking and remarkable, usually called up by some peculiarly curious fact in connection with the special subject upon which they

happen to be engaged, and then quickly dismissed as a barren topic, unworthy of further investigation. A singular resemblance thrusts itself upon the attention, claims a passing allusion, and is no more thought of. My object, therefore, in the present paper, is to dwell more at length upon the vast number of recurrent forms met with in the *animal* kingdom, referring to the considerations which seem to be derivable from them, and the generalizations which appear to be legitimately deducible from the enquiry.

It will probably occur to some, at the first blush, that organic homomorphism has a correlative in the inorganic world; but the restricted definition already given will exclude the class of representative forms known to the chemist under the name of *isomorphous*. This term refers to a similarity of crystalline form, assumed by substances (even compounds) of different constitution, a strong corroborative argument in favour of Wollaston's theory of the simple form of atoms.* But Mitscherlich has shown that isomorphism implies, primâ facie, in bodies subject to it, a certain agreement of chemical properties, which may be regarded as the analogues of organic functions. Thus, "the acids of arsenic and phosphorus form salts which crystallize alike, and their respective bases not only correspond in a more general way in acquiring acid properties with oxygen,—forming gaseous compounds with hydrogen, &c., but also in the unusual proportions in which oxygen and hydrogen enter into union with them,—while the corresponding arseniates and phosphates also agree in taste, and in the degree of force with which they retain their water of crystallization."† This similarity of properties therefore raises isomorphous bodies from being homomorphs to the dignity of analogues.

The animal kingdom has been so severely scrutinized during the last half century by men of keen perception, such

* Bakerian Lecture, 1818. † Daubeny, Atomic Theory, p. 170.

as Cuvier, Owen, Huxley, and others, that science is no longer at a loss for the key to the general plan upon which it has been constructed. The study of morphology, or the science of form in connection with structure, has demonstrated that there is a certain unity of plan running throughout it; and that although it is impossible to construct an archetype which shall stand for all animals, it can be shown that four such archetypes, or at most, five, will represent the primary forms around which, as centres, the whole animal kingdom may be grouped. This being the case, we might expect that there would be a certain degree of similarity of form among animals; indeed, on learning these facts, we might be disposed to look for and expect a far greater degree of similarity than we shall find; and we cannot help feeling surprised at the vast and interminable variety of form which is made as it were the vehicle for the modification of four or five types. But Nature is inexhaustible in resources, and variety is one of the charms of Nature which the Creator has afforded in an eminent degree for the adornment of the earth, and for the intellectual exercise of his highest creatures.

It is often said that no two things are alike in nature,—and with truth,—for the resemblance, whether in outward form, or in internal organization, always partakes of the character of a *near approach*, and never of direct repetition. It must not be supposed that homomorphism means repetition—Nature never repeats herself; the resemblance may be striking, and such as at first sight may cause the uninstructed to confuse together animals of very different groups; but a close study of either by degrees reveals differences no less striking than are the points of resemblance. Of this many instances will be adduced as we proceed. And this rule is constant throughout nature; for even in the inorganic world, where the resemblances are even more close than in the organic, (inasmuch as the forms assumed by inorganic matter, such as

crystals, are far more simple than those exhibited by organized beings,) this fact has long been recognised. Some writers, indeed, who aim at greater precision of language in chemical technology, have proposed the term *plesiomorphism*, as a substitute for *isomorphism*; and Daubeny, while he objects to the necessity of the change, yet admits "that it would be perhaps difficult to point out two bodies which are exactly isomorphous."*

It cannot be a matter of surprise, considering the number of such resemblances existing throughout the animal kingdom, that while the study of homologies was making but slow progress, and the true affinities of animals were but little understood, the real nature of many aberrant forms should have been lost sight of in the contemplation of their homomorphic resemblances. Who can wonder if Pliny spoke of the bat, as "the onely bird that suckleth her little ones," in quaint old Holland's phraseology? What malacologist even can feel surprise that up to recent times the Polyzoan molluscoids were mistaken for zoophytes, or that Lhuyd, and at one time the illustrious Ellis, should have regarded them both in the light of "remarkable sea-plants;" while his predecessor, Baker, had even looked upon them as the production of "salts incorporated with stony matter."† Who can wonder that before the time of Savigny, the tunicated Botrylli should have been regarded as polyps—that Linnæus should have placed Teredo among the annelids—that before the Memoire of Dujardin in 1835, the Foraminifera should have been classed with the cephalopodous mollusca? In all these cases, (and others might be brought to swell the list,) the animals have been raised, or have sunk from one *sub-kingdom* to another, and have even *overleaped* a whole sub-kingdom, to take that place in the scheme of nature which their affinities

* Atomic Theory, p. 175.

† Employment for the Microscope, p. 219.

numerous animals, among which were Elephas primigenius Rhinoceros tichorrhinus, Bos primigenius, Cervus tarandus, Equus fossilis, Lepus diluvianus, Ursus spelæus, Hyæna spelæa, Felis spelæa. When the lake, swollen at some time or other by excessive torrents, overflowed its banks, many of the inhabitants of the district were drowned, and when a part of the mountain which hemmed in the water suddenly gave way, the dead bodies were carried downwards by the flood into the crevices and hollows of the country below. The bones

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This German discovery is, I think, far from being of the same nature as the one lately made in the neighbourhood of Oxford, and which I will briefly describe here. The extensive gravel beds of Yarnton, having been laid open a few years ago, during the construction of the railway, grinders and tusks of the mammoth commingled with human bones and fragments of pottery were brought to light in great abundance.

Professor Phillips, who visited the locality, found at a depth of sixteen feet from the surface,—first, Oxford clay; next a bed of glacial drift, on the top of which were a great many elephant's teeth; and lastly, an irregular series of gravel, sand, and loam deposits, with dark patches occurring throughout the layers. These darker parts being closely examined were found to be nothing more than ancient British burial places full of human bones and pottery, and from their immediate proximity to the remains of the extinct elephant, a superficial observer might very easily have concluded that they had been simultaneously deposited.

I feel fully persuaded, however, that no mistake of this kind has occurred at Köstritz, and I see no way of resolving the difficulty but by acknowledging contemporaneity in life of the various extinct organisms found there.

Robert Eisel seems to think that the indubitable co-existence of our race with the mammoth, tichorrhine rhinoceros, cave bear, &c., rather proves that these animals lived at a much more recent period than is generally admitted, than that man commenced his existence at an earlier date than the usual chronology warrants.* And this view I think is not rendered less tenable by such facts as the following:—

The celebrated mammoth, discovered at the commencement of the present century in the ice-bound shores of the river Lena, in Siberia, appears to have been in such a wonderful state of preservation when disintombed, that the Yakoutski are said to have fed their dogs on as much of its flesh as was not devoured by beasts of prey.

There seems to be no reason for doubting the truth of this statement; at any rate the skeleton of the animal together with a considerable portion of its skin and hair, as well as the eyeballs and the hoofs, may be seen in the Imperial Academy of St. Petersburgh at the present day.

Remains too of this primeval elephant have been found in peat near Holyhead, and its tusks in most instances are so little altered that they are constantly employed for the same purposes as ordinary ivory.† Pallas in his "Voyage dans l'Asie Septentrionale," records the discovery of the carcase of a tichorrhine rhinoceros in frozen soil, and the skin, tendons and flesh appear to have been perfectly unchanged.‡

* Mr. Prestwich at the conclusion of his memoir on the valley of the Somme flint implements, expresses precisely similar opinions, for he remarks that—"he "does not consider that the facts as they at present stand, carry back Man in past "time, more than they bring forward the great extinct Mammals to our own "time, the evidence having reference only to relative and not to absolute time."—*Proceedings of the Royal Society*, vol. x, No. 35, p. 58.

† See the story of "The Ivory Mine" in Chambers's Papers, vol. ii.

‡ Op. cit. pp. 130-132, quoted by Prof. Owen in his "Palæontology," p. 366.

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From this it will readily appear that the study of homomorphism cannot be expected to be so prolific of important results as the study of homologies, inasmuch as these latter are believed to be the bonds of connection which unite forms apparently widely separated, and which throw light upon the true affinities of obscurely constituted organisms. And herein probably lies the reason why homomorphism has attracted so little attention from naturalists. I am not aware of any essay (though such there may be) upon this curious subject, which either collects and compares the various examples with which Nature abounds,—or, still less, which attempts to treat it upon such a basis as that on which all natural science should be treated. It appears indeed to be barely referred to here and there in the writings of zoologists, as something striking and remarkable, usually called up by some peculiarly curious fact in connection with the special subject upon which they

happen to be engaged, and then quickly dismissed as a barren topic, unworthy of further investigation. A singular resemblance thrusts itself upon the attention, claims a passing allusion, and is no more thought of. My object, therefore, in the present paper, is to dwell more at length upon the vast number of recurrent forms met with in the *animal* kingdom, referring to the considerations which seem to be derivable from them, and the generalizations which appear to be legitimately deducible from the enquiry.

It will probably occur to some, at the first blush, that organic homomorphism has a correlative in the inorganic world; but the restricted definition already given will exclude the class of representative forms known to the chemist under the name of *isomorphous.* This term refers to a similarity of crystalline form, assumed by substances (even compounds) of different constitution, a strong corroborative argument in favour of Wollaston's theory of the simple form of atoms.* But Mitscherlich has shown that isomorphism implies, primâ facie, in bodies subject to it, a certain agreement of chemical properties, which may be regarded as the analogues of organic functions. Thus, "the acids of arsenic and phosphorus form salts which crystallize alike, and their respective bases not only correspond in a more general way in acquiring acid properties with oxygen,—forming gaseous compounds with hydrogen, &c., but also in the unusual proportions in which oxygen and hydrogen enter into union with them,—while the corresponding arseniates and phosphates also agree in taste, and in the degree of force with which they retain their water of crystallization."† This similarity of properties therefore raises isomorphous bodies from being homomorphs to the dignity of analogues.

The animal kingdom has been so severely scrutinized during the last half century by men of keen perception, such

* Bakerian Lecture, 1813.

† Daubeny, Atomic Theory, p. 170.

as Cuvier, Owen, Huxley, and others, that science is no longer at a loss for the key to the general plan upon which it has been constructed. The study of morphology, or the science of form in connection with structure, has demonstrated that there is a certain unity of plan running throughout it; and that although it is impossible to construct an archetype which shall stand for all animals, it can be shown that four such archetypes, or at most, five, will represent the primary forms around which, as centres, the whole animal kingdom may be grouped. This being the case, we might expect that there would be a certain degree of similarity of form among animals; indeed, on learning these facts, we might be disposed to look for and expect a far greater degree of similarity than we shall find; and we cannot help feeling surprised at the vast and interminable variety of form which is made as it were the vehicle for the modification of four or five types. But Nature is inexhaustible in resources, and variety is one of the charms of Nature which the Creator has afforded in an eminent degree for the adornment of the earth, and for the intellectual exercise of his highest creatures.

It is often said that no two things are alike in nature,—and with truth,—for the resemblance, whether in outward form, or in internal organization, always partakes of the character of a *near approach*, and never of direct repetition. It must not be supposed that homomorphism means repetition—Nature never repeats herself; the resemblance may be striking, and such as at first sight may cause the uninstructed to confuse together animals of very different groups; but a close study of either by degrees reveals differences no less striking than are the points of resemblance. Of this many instances will be adduced as we proceed. And this rule is constant throughout nature; for even in the inorganic world, where the resemblances are even more close than in the organic, (inasmuch as the forms assumed by inorganic matter, such as

crystals, are far more simple than those exhibited by organized beings,) this fact has long been recognised. Some writers, indeed, who aim at greater precision of language in chemical technology, have proposed the term *plesiomorphism,* as a substitute for *isomorphism ;* and Daubeny, while he objects to the necessity of the change, yet admits "that it would be perhaps difficult to point out two bodies which are exactly isomorphous."*

It cannot be a matter of surprise, considering the number of such resemblances existing throughout the animal kingdom, that while the study of homologies was making but slow progress, and the true affinities of animals were but little understood, the real nature of many aberrant forms should have been lost sight of in the contemplation of their homomorphic resemblances. Who can wonder if Pliny spoke of the bat, as "the onely bird that suckleth her little ones," in quaint old Holland's phraseology? What malacologist even can feel surprise that up to recent times the Polyzoan molluscoids were mistaken for zoophytes, or that Lhuyd, and at one time the illustrious Ellis, should have regarded them both in the light of "remarkable sea-plants;" while his predecessor, Baker, had even looked upon them as the production of "salts incorporated with stony matter."† Who can wonder that before the time of Savigny, the tunicated Botrylli should have been regarded as polyps—that Linnæus should have placed Teredo among the annelids—that before the Memoire of Dujardin in 1835, the Foraminifera should have been classed with the cephalopodous mollusca? In all these cases, (and others might be brought to swell the list,) the animals have been raised, or have sunk from one *sub-kingdom* to another, and have even *overleaped* a whole sub-kingdom, to take that place in the scheme of nature which their affinities

* Atomic Theory, p. 175.

† Employment for the Microscope, p. 219.

claimed for them. So late as 1812, the whales and dolphins were classed in a systematic work as "cetaceous fishes." Even now, indeed, many an animal is provisionally placed in a position which it occupies, perhaps solely, by its morphic analogies, because, from the rarity of its occurrence, or from the difficulty of bringing specimens under the scalpel of competent anatomists, its true homologies cannot be tested, and its correct position verified.

These homomorphic resemblances, however, have proved useful in their way, by affording an easy clue to a nomenclature which shall be at once apt and serviceable. Amidst the vast number of species requiring to be distinguished by a generic and specific name, systematists are often hard pressed to frame a new designation; since the same name given to two species, or even to two genera, however widely separated, is liable to lead to confusion. The inevitable result is that the most barbarous words are constantly being coined in the natural history mint, and bad Greek and Latin are mixed up with native names in nearly all the dialects of the world; and these, with a dash of the Smithii, and Jonesii, and Brownii, form altogether a Babel which is the opprobrium of natural history. But a homomorphic resemblance at once suggests a *natural* nomenclature, that is to say, a word which, by indicating the nature of the resemblance, is at once an appropriate name, and a good guide to others in the recognition of the animal *Auricula Midæ* (Lam.) is an excellent name, not only affording a clue to the shell referred to, but also delighting the scholar with the imaginative associations raised up by the beautiful classic fable on which it is founded. Few names indeed are so happy, but still such as *Cestum Veneris*, *Phyllium siccifolium*, *Crioceratites*, *Ophiura*, and the like, contrast favorably with such cacophonisms as *Hyperöodon Butzkopf*, *Pterodictycus potto*, *Balæna Agamachshik*, (Pallas), *Notopocorystes Broderipii*, or *Ardea brag!*

But although they were not always recognised as such, the existence of recurrent forms in nature could not be overlooked by the framers of systems, inasmuch as they were stumbling-blocks which almost seemed placed in their path to prevent the natural arrangement of animals from being too easy a task. A too cursory examination has not unfrequently resulted in the false position of an animal, only to be detected and triumphantly exposed by a succeeding zoologist; for not only are classes and sub-kingdoms homomorphically represented by widely separated ones, but the naturalist has often been led into exclamations of surprise at the remarkable homomorphisms existing between orders of the same class. These curious resemblances cannot better be illustrated than by comparing, first the classes of the vertebrata one with another, secondly the vertebrata with the invertebrata generally, and thirdly the sub-kingdoms of the invertebrata one with another.

Beginning then with the classes of the Vertebrata,—every one knows, whether he have thought about it or otherwise, that the four vertebrate classes are homomorphically connected. Thus, there are flying mammals, such as the bats and flying squirrels (Pteromys) uniting them with the class Aves; as well as that anomalous monotreme, the ornithorhynchus, or web-footed duck-bill. The Edentata among quadrupeds connect them with reptiles, by means of the armadillos; the great armadillo (Dasypus gigas), and prëeminently, the mataco (D. apar), being homomorphic with the Testudinata; while to the saurian reptiles they are united by the scaly pangolins (Manis), and to the extinct pterosaurians (Pterodactyls) they are again united by the bats. With fishes, the mammalia are most singularly connected by the cetacea; while a special resemblance appears between the narwhal (Monodon) and the sword-fish (Xiphias.) The homomorphic resemblances between birds and reptiles are not so striking, but the Draconine

saurians or flying lizards (Draconis sp.) supply examples, and the extinct pterodactyl once afforded another; while with fishes, the various species of flying fish (Exocœtus) among the soft-finned, and flying gurnards (Dactylopterus and Pterois) among the hard-finned, are good illustrations. It only remains to connect reptilian forms with fishes, and here the snakes (Ophidia) with the eels may well be compared, and less striking instances of resemblance occur between the saurian reptiles, such as the alligator, and the bony-cased sturgeon; and between the testudinata and the trunk-fishes (Ostracion.) Perhaps also that great enaliosaur, the Ichthyosaurus, might be here mentioned.

I remarked just now, that even between orders of the same class very curious homomorphisms may be observed; and I will select the class mammalia as the best one with which to illustrate this remark. The organic structure and affinities of one *order* are dissimilar from those of another, just as the structure and affinities of one *class* differ from those of another; the difference between class and order being one of *degree* and not of *kind;* so that it is as remarkable to find resemblances of form in widely separated orders, as in still more widely separated classes, although, of course, homomorphic resemblances are more striking between orders than between classes. Let us take, for example, the order quadrumana, (for I will not speak of the homomorphism existing between the bimana and the quadrumana,) and we shall find among them representative forms of various other orders. Thus, the genera Midas and Jacchus, known as marmozets, true platyrrhine quadrumana, represent the rodentia through the genus Sciurus (squirrels); and the Douricouli (Nyctipithecus felinus), in the same division, represents the cat (Felis) in the digitigrade carnivora; while among the strepsirrhine quadrumana, the loris (Stenops tardigradus) represents the true sloths in the order bruta, and the very

aberrant animal, falsely called the flying squirrel (Galeopithecus), is the representative of the order cheiroptera or bats.

Among the pachydermata are some no less striking examples of species, homomorphic with those of other orders. Thus, the hyrax, an animal in structure intermediate between the rhinoceros and the tapir, a miniature rhinoceros as it has been called, yet so closely resembles the rodentia in its outward form, that it was long classed with them, and Cuvier makes the following remark concerning it: "There is no quadruped," he says, "which proves more forcibly than the daman (Hyrax capensis) the necessity of having recourse to anatomy as a test by which to determine the true relationship of animals."

The general resemblance between the cetacea and the pinnigrade carnivora (seals) need only be referred to; it is made very distinct through the herbivorous family Manatidæ, especially the dugong (Halichore dugong.)

We have seen how the loris resembles the sloth; and on the other hand, the edentate genus Bradypus (Ai) bears a singular resemblance to monkeys in general, even in that particular which is so characteristic of them, viz., their physiognomy,—while it has a carnivorous homomorph in the sloth bear (Ursus labiatus), called by Pennant the ursiform sloth, and by Shaw, Bradypus ursinus.

The insectivora are connected through the hedgehog (Erinaceus Europæus) with one of the most anomalous of animals, the singular monotreme genus Echidna, which has besides other homomorphs to be afterwards mentioned; and further through the shrews (Sorecidæ), with the rodent genus, Mus; and with the carnivora, by the bulau (Gymnura Rafflesii) of the East Indies, formerly described as a Viverra.

The rodentia are united homomorphically with the pachydermata by means of the capybara (Hydrochœris capybara, Buff.), formerly called, from its pig-like appearance, Porcus

fluviatilis (Fermius), thick-nosed tapir (Pennant), cochon d'eau (Desmarchais), and Sus maximus palustris (Barrère.) By the flying squirrel (Pteromys) they claim some homomorphic affinity with the cheiroptera; but their chief homomorphism is with the marsupialia, and most striking are the resemblances. Not only do the rodentia and marsupialia bear a general mutual resemblance throughout,—both orders possessing that extraordinary development of the hinder extremities and tail, which enables the jerboas in common with kangaroos to take such wonderful leaps,—but there are particular animals in both orders which bear a most remarkable resemblance to one another. Thus, the rodent jerboas (Dipus) are closely imitated by the tufted-tailed rat-kangaroo (Hypsiprimnus penicillatus, Gould); and the true kangaroos (Macropus) are equally nearly approached in form by the Cape leaping hare (Pedetes capensis, Ill.) There is also a considerable resemblance between the wombat or badger of the Australian colonists (Phascolombys Wombat, Per. and Les.) and the rodent cavies and lagomys; while a further homomorphism occurs between individuals belonging to aberrant groups in either order, viz., the Brazilian porcupine (Synetheres) among the rodents, and the echidna among the monotremes, whose relation to the insectivora has already been pointed out.

These external resemblances between rodents and marsupials are none the less remarkable when we learn that there is less true affinity between them than between the marsupials and most other orders; for Mr. Waterhouse, in his excellent "History of the Marsupialia," remarks that in them "we find representatives of most of the other orders of mammalia: the Quadrumana are represented by the Phalangers; the Carnivora by the Dasyuri; the Insectivora by the small Phascogales; the Ruminantia by the Kangaroos; and the Edentata by the Monotremes." He adds "The Cheiroptera are not

represented by any known marsupial animals, and the rodents are represented by *a single species only;*" the species here referred to being the wombat.

Lastly the marsupialia, besides their homomorphism with the rodents, have through the ursine opossum, or native devil of Van Diemen's Land (Dasyurus,) a singular relationship to the carnivorous genus, Ursus; as well as through the squirrel petaurus, to the bats.

I shall not here attempt to follow out the homomorphisms existing in the orders of the class Aves, because it would make the present paper too long for the occasion; but they will be found to be not less striking than those of the mammalian orders; and I will content myself with an illustration by means of the first, or rapacious order. Here the elegant Nauclerus furcatus, or swallow-tailed kite, stands for the passerine genus Hirundo; and the Egyptian vulture (Cathartes aura) is singularly matched by the rare Corvus gymnocephalus, or bald-headed crow, of Guinea. The scansores are connected by the similarity between the sparrow-hawk (Accipiter nisus,) and the cuckoo (Cuculus canorus,) as well as more generally between the owls and parrots. The burrowing owl (Noctua cunicularia,) of America, unites the rapacious with the rasorial birds—the anomalous secretary bird (Gypogeranus,) of Africa and the Philippines, connects them in a most remarkable manner with the grallatores, and the çariama (Sariama cristata,) in particular, for which it might readily be mistaken. The long legged harriers (Circus,) also maintain the resemblance, while the sea eagle (Haliäetos) completes the homomorphism, by connecting the raptorial birds with the natatores through the albatross (Diomedea.) Having thus illustrated one order I will quit this class of birds, only calling attention to the remarkable general resemblance between the rare Conirostral genus opisthocomus and the rasorial guans (Penelope,) the fissirostral hirundines and the natatorial terns (Sterna,)

and the grotesque parrots, and equally grotesque puffins, (Fratercula.)

We shall not find it so easy to discover homomorphic resemblances among the reptiles, for there is no class which exhibits less variety within the limits of its orders, and the observation of Professor Bell, in his "Monograph of the Testudinata," with respect to the tortoises, may be applied with nearly equal force to the whole class Reptilia. "At present," says that eminent erpetologist, "they certainly remain the most isolated order, not only amongst the reptiles, but perhaps in the whole animal kingdom." Small indeed, in number, as a class, the four orders into which they may be divided are singularly characteristic and circumscribed, as well as constant in their characters. The chelonian reptiles shut up in their unyielding box—the saurians, all more or less lacertine in form—the elongated and simple ophidians, nor the short and long-tailed amphibians are capable of the same degree of diversity as are the other vertebrate classes; and although I have pointed out their homomorphic connection with the latter, with the aid of extinct forms, it is not easy to find homomorphic individuals in distinct orders, except among the lacertine sauria, and the long-tailed amphibia. When, however, they do apparently occur, it becomes probable that they are of the nature of *links* connecting different orders, and therefore partake of homological rather than homomorphic resemblance, and are inadmissable for our purpose.

A different remark, however, is applicable to the class of *fishes*. There is perhaps no tribe of animals, not even excepting the vast class of insects, which present such extraordinarily singular and eccentric forms, as do fishes. There is no degree of anomalous shape, nothing so marvellously *outré* which the imagination can conceive, which is not paralleled in this most wonderful class. I venture to say that if a person of the wildest fancy, but unacquainted with piscine

forms, were to depict in his most exuberant moments an imaginary creature, as unlike any living being as he could conceive, some finny reality might be advanced to cap the monster. Take for example, and as a familiar instance, the hammer-headed shark (Zygana laticeps,) or the painted angler (Lophius pictus,) or the viper-mouthed pike (Esox viridis,) or Syngnathus foliatus, Stylophorus chordatus, Raia fasciata, and a host of others, which might easily be mentioned. But with all this wonderful variety, the forms of fishes are *sui generis*, and in no class is it less easy to find homomorphic shapes. Their morphic affinity to the other vertebrate classes has been already indicated, but order with order has little in common. The inexhaustibility of Nature's plastic resources is shown in no class to more advantage; and yet, strange to say, there is no class in which I have succeeded less in tracing homomorphic resemblances.

There is a remark which has occurred to me, and which, though it will be proper to introduce it here, must be carefully borne in mind, as it will be particularly referred to hereafter; namely, that among such animals as bear homomorphic resemblance to those of another and differently organized group, an agreement in form is generally accompanied by a singular agreement in habits. It matters not how different are the habits of the group to which it homologically belongs, from those of the group which it homomorphically resembles; it diverges from its own tribe as much in its *actions* as it does in *form*, as though a certain external configuration necessitated certain habitual movements. A few examples will illustrate my meaning, taken from within a class, where such habits are more easily compared than in animals of different classes. Thus the ursine opossum (Dasyurus ursinus,) widely separated as it is from the plantigrade carnivora, not only agrees far more closely with a bear in form than with its own congeners, having a short, clumsy figure, and plantigrade step, but it is

said of them by their discoverer that "they frequently sat on their hind parts, and used their fore paws to convey food to their mouths; and many of their actions, as well as their gait strikingly resembled those of a bear."* The quadrumanous douricouli, (Nyctipithecus felinus,) not only resembles a cat in form, but is, like it, nocturnal in its habits, glides about with the stealthy movements of a cat, and "when irritated, in the posture it assumes, and the puffed state of the fur, it resembles a cat attacked by a dog." The pachydermatous hyrax lives gregariously in burrows, like the rabbits which it so much resembles in form. The echidna rolls itself up into a ball when disturbed, like its homomorph, the hedgehog. The lemurine Galeopithecus makes its flight with its young attached to the nipple, as do the true bats. The habits and food of the sea-eagle closely agree with those of the albatross; and the burrowing-owl is diurnal in its habits, and uses its feet more or less for purposes of scratching, in both which respects it differs from its congeners, and agrees with the Rasores, which it resembles in form.

Besides, however, the general homomorphism connecting whole animals in different classes or orders, it is at least curious that there are certain appendages in each class, which are characteristic of certain individuals, and distinguish them perhaps from every other, not only in their order, but in their class, but which reappear homomorphically in certain individuals in the other classes. Such an appendage is the nasal horn of the rhinoceros, which is so peculiarly distinctive of that animal. Among birds there are several instances of a central horn, but it usually springs too high up on the forehead to bear out the resemblance; as for instance the horned screamer (Palamedea cornuta). In the carunculated chatterer of Brazil, (Procneas nivea,) the appendage, which is not really

* G. P. Harris, in Linn. Trans. ix., 174.

a horn, is situated far in front of the eyes, and better represents the rhinoceros' horn; in the rough-billed pelican, however, (Pelicanus trachyrhynchus,) a stout horn-like excrescence really grows from the middle of the upper mandible; and in some species of hornbill, (Buceros,) the analogy is well carried out. Among reptiles, the extinct Iguanodon distincly reproduces the nasal horn, though it was small in comparison with the size of that colossal brute. There are many fishes which possess a single central horn, but in some of them, as in the birds, it is situated too high up on the head to bear out the resemblance. This is the case with the genus Monacanthus; but in Naseus fronticornis of Cuvier a horizontal horn projects in front of the eyes; in Chimæra monstrosa of Bloch, an inconsiderable appendage occurs in the middle of the nose; while the true homomorph perhaps may be considered to be a very rare fish, Lophotes siculus, of Swainson, of which a specimen exists in the British Museum. Here the first dorsal ray assumes the form of a horn-like process, a palm and-a-half long, Sicilian measure, somewhat three sided and pointed.

The proboscis also, so characteristic of certain pachydermatous mammalia—but which is not peculiar to them—being found in the elephant-seal (Macrorrhinus proboscideus,) as well as in some Insectivora, as Solenodon paradoxus, may be seen repeated in such birds as have the upper mandible longer than the lower, but particularly in the Heterorhynchus olivaceus of Lesson,* supposing that bird to be a normal form. Among reptiles, proboscidian forms are numerous in serpents of the genera Rhinophis, Langata nasuta, &c., and the remarkable Matamata of Cayenne, (Chelys fimbriata, Spix,) an aquatic chelonian, possesses a nasal development, precisely similar to the tapir among quadrupeds. The proboscidian species of

* Magasin de Zoologie, 1839.

fish are best represented by the curious frog-fish (Malthe nasuta,) and the extraordinary sword-fish (Xiphias gladius).*

The horns characteristic of ruminant mammalia, are paralleled, as simple elevations, by the tufts on the heads of owls of the genera Scops, Bubo, and Otus. The Egyptian Cerastes, or horned viper (Vipera cerastes,) among reptiles, and the eared trunk-fish (Ostracion auritus, of Shaw,) a formidable-looking native of the Indian seas, complete the analogy. So also with the frill round the neck from which the frilled lizard (Chlamydosaurus Kingii,) takes its name, whatever its use, it is nearly approached in form by the union of the pectoral fins of either side at their base in certain fishes, as the lump-sucker (Cyclopterus,) of our own shores; while among birds, the ruff (Machetes pugnax,) takes its name from a similar development of feathers round the head, seen also in certain humming birds, as Trochilus ornatus, and tricolor. In quadrupeds, hair supplies the resemblance in such animals as the full-maned colobus, or full-bottomed monkey of Pennant, (Colobus polycomus.) And lastly, the pouch of the pelican finds its representative in the Iguanas among reptiles.

Having thus examined the homomorphisms which exist within the sub-kingdom vertebrata, we have next to enquire what morphic connection is found between it and the other great division of *in*vertebrata. We can hardly expect to find in animals constructed on so different a plan as are the invertebrates generally from the vertebrates, that there should be so much recurrence of form between them, as we have found within the vertebrate sub-kingdom, all the members of which may be reduced to one archetypal form; nevertheless we shall meet with some striking instances of it.

Let us commence with the Mammalia; and here we find a

* It is perhaps worthy of remark that a proboscidian form occurs among the invertebrata. Thus, in the curious annelid, (Derris sanguinea,) a native of our shores, "the mouth consists of two lips, the lower one straight and fixed, the upper one hooked and moveable."—*John Adams, in Linn. Trans.*, iii., 68.

general resemblance of form between the mailed armadillos and the molluscous chitons; the isopodous crustaceans, Oniscus, and Lygia, and the fossil Nileus armadillo. The extraordinary development of the posterior extremities in the marsupials and rodents is paralleled in a remarkable manner among the Insecta by the kangaroo-beetle (Scarabæus macropus); and some of the Tardigrade arachnida, or water-bears, have a most ludicrous resemblance to certain mammalia, as may be seen particularly between Echiniscus suillus,* and a pig, or perhaps rather the insectivorous genus Centetes.

Passing on to birds, the homomorphism which is borne to them by winged insects generally, and more particularly by the stout-bodied moths and sphyngidæ, will be at once recognised. Between special birds and special insects even, homomorphism may be established. Thus the Nemoptera angulata of Latreille, a neuropterous insect, from the peculiar direction and form of its posterior pair of wings, bears a near resemblance to more than one species of Cynanthus, among the trochilid family of humming birds, as well as to the scissor-tailed blackcap (Gubernetes Yetapa, Viell,) of South America. And what closer resemblance can be looked for than that between the head of the vulture, and the avicularia, or bird's head appendages so common in the polyzoa, especially Bugula, and which are considered by Huxley to be truly a part of these molluscoids, and not of a parasitic nature.

Among the Invertebrata, we find no less striking recurrent forms of reptiles. Thus the snakes are represented by the terricolous annelids; as well as by the Ascaris lumbricoides and Strongylus among the nematoid entozoa. A very curious special homorphism also happens between the Siphonops (Cecilia annulata,) and the common earth-worm (Lumbricus terrestris.) The shelled Testudinata have a singular homomorph in a shelless mollusk, viz: the tunicated Chelysoma, so

* Ehrenberg Microgeologie, pl. 36.

called from this resemblance; as well as in the chitons, and the remarkable coccus described by Shaw as Coccus cataphractus, or the mailed coccus, connects them with insects.

Nor are the fishes altogether without their invertebrate imitators. The Diodon hystrix, or porcupine diodon may be compared with an echinus; the head of the anomalous hammer-headed shark has a parallel in the dipterous genus of insects, Diopsis, as well as the Achias oculata of Latreille, remarkable for the enormous prolongations of the sides of the head; and the curious little Pegasus draco, is the counterpart of a pteropodous mollusc.

Let us now dismiss the Vertebrata, and launching into the midst of the vast host of invertebrate animals, let us see what homomorphisms exist among their various classes and orders, dividing them simply and conveniently into mollusca, annulosa, cœlenterata and protozoa. Let us then begin with the mollusca. The tubicolous annelids are well represented through the Serpulæ and Vermiliæ, by the tubulibranchiate molluscan genera, Vermetus and Siliquaria. The pteropod genus, Spiratella (S. limacina,) bears a close resemblance to the tubicolous Spirorbis; as does also the freshwater Planorbis among the gasteropods. The limacine slug, Vaginulus, resembles the leech (Hirudo,) among the suctorial annelids; while the cyclobranchiate genus Chiton is homomorphic with certain species of dorsibranchiate annelids, the agreement perhaps being most complete between Chiton spinosus and Aphrodite hispida. The conchiferous Teredo was placed by Linnæus (who was misled by its morphic analogies,) among his Vermes, between serpula and sabella. The cœlenterata also possess their share of homomorphism with the mollusca,—principally, however, through the molluscoids of Milne Edwards. Among these, the tunicated genus Botryllus revives in appearance that radiism which seemed to have disappeared with the echinoderm Sipunculidæ, and bears a close

resemblance to the first section of the Lamarckian division of corals, called Astræadæ, and of which Astræa rotulosa is a good example.

The lowest division of the mollusca, however, afford as a class, the most singular example of homomorphism which exists in the animal kingdom. The polyzoa, as Huxley remarks, "are as truly and as wholly molluscan as any other mollusca;" but even up to the year 1827, they were universally confounded with the sertularian, and other zoophytes. It was Dr. Grant, who, in that year, in his "Observations upon the Structure and Nature of Flustræ," announced the peculiar ciliated character of the tentacles, and the molluscan type of the intestinal canal, and thus raised these animals, as Busk observes "from one sub-kingdom to another." None but those who have studied these two groups in their relation to one another, can properly appreciate their remarkable resemblance;—the oral tentacles in both arranged in circlets—their compound character, the form and very nature of the polyparies, sometimes horny, sometimes calcareous, agree so curiously, that no examples of homomorphism could be more apt to set the mind meditating upon the philosophy of these resemblances, and searching for their final causes. It is however the cheilostomatous, or marine division of the polyzoa which chiefly represents the polyps; for in the fresh-water, or hippocrepian group, with the exception of the genera Fredericella, and Paludicella, the tentacles are set upon a peculiar horseshoe-shaped prolongation, or lophophore, which to a certain extent modifies *their* homomorphism with the sertularian polyps. But here another sub-kingdom steps in, and an annelid was discovered in 1856, by Dr. Strethill Wright, on shells from Torquay, and described by him in the "Edinburgh New Philosophical Journal," for that year, which appears to be the homomorph of the hippocrepian polyzoa, and has hence received from Dr. Wright the name of Phoronis hippocrepia.

called from this resemblance; as well as in the chitons, and the remarkable coccus described by Shaw as Coccus cataphractus, or the mailed coccus, connects them with insects.

Nor are the fishes altogether without their invertebrate imitators. The Diodon hystrix, or porcupine diodon may be compared with an echinus; the head of the anomalous hammer-headed shark has a parallel in the dipterous genus of insects, Diopsis, as well as the Achias oculata of Latreille, remarkable for the enormous prolongations of the sides of the head; and the curious little Pegasus draco, is the counterpart of a pteropodous mollusc.

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We have next to point out the homomorphisms between the second invertebrate sub-kingdom, annulosa, with the cœlenterata. Considering, however, that *annulism* is the type of the one, and *radiism* of the other, it is obvious that they are incompatible with much resemblance, and can have but little in common. The very names of annulose and radiate animals indicate that they are natural divisions presenting a marked constancy to the particular forms which have given rise to those terms; and it is only in some doubtful or aberrant groups, at either extremity of the cœlenterate class, that any resemblance to the Annulosa can be traced. Thus, among the nematoid entozoa, as Strongylus, Ascaris, &c., which, however, form the last group of Huxley's *Annuloids*, there are animals bearing a close resemblance to the typical annelids, as on the other hand do the vermiform Echinodermata, as Holothuria, and particularly Sipunculus. With regard, however, to the affinities of these latter, naturalists are not agreed, and Professor Huxley, whose opinion is worthy of great respect, places the echinodermata in the annuloid division of the Annulosa.*

Between the various subdivisions of the large sub-kingdom Annulosa, however, singular resemblances may be traced. Thus, the insecta reproduce the form of the arachnida in the orthopterous Acheta arachnoides, or spider-like cricket of Jamaica, as well as in the apterous genus Phalangium, of which P. reniforme has the aspect of a spider, and P. cancroides was considered both by Swammerdam and Roesel to be a scorpion. This arachnoid appearance is also shared in the crustacea by the macrourous decapod Thalassina scorpioides, of the Chilian coast, which, as its name indicates, also bears a close resemblance to a scorpion. The dipterous Tipula is homomorphic with the araneiform edentate crustacean, Nymphon gracile ; as well as with the macropodian genus

* Med. Gazette, vol. xxxiv., p. 638.

Leptopodia, or sea spider; and the form of the orthopterous genus of insects Mantis, is reproduced in the macrourous decapod, Squilla mantis. The myriapodous genus Scolopendra (Centipede,) represents the annelidans through such forms as Phyllodoce; and the Julus through the nereid, Ioida macrophthalma. Insects, too, of different orders, will bear a close comparison, as the lepidopterous Sesia apiformis with the hymenopterous bees; the sphynx, Macroglossa bombyliformis, with the dipterous Bombylius; and this again with the hymenopterous Bombus; the homopterous Aphis (as A. sorbi,) and the neuropterous Phryganea; the dipterous Syrphus and the hymenopterous wasp; the orthopterous Phasma, or walking-stick insect, and the smaller hemipterous family of hydrometridæ as Hydrometra and Velia.

The tubicolous annelid, Pectinaria belgica, is the homomorph of the Limnias ceratophylli, among the rotifers, wherever that curious order may be located.

Between the cœlenterata and protozoa, there are no less striking resemblances, not only through the foraminifera which will be alluded to presently in connection with another subkingdom, but also through some curious compound forms of polypine infusories, of which Carchesium polypinum is a good example, as representing the campanularian zoophytes, as would also the well-known Vorticella; while Dinobrion sertularia, another form, is so called from its resemblance to a sertularian zoophyte; and this also completes the morphic relations of the polyzoan molluscoids. The curious rhizopod, Actinophrys sol, also is naturally referred to the echinite forms, particularly to the long-spined species, such as Cidaris papillata, &c.

With the exception of those between the polyzoan molluscoids and the hydroid polyps, there are none more worthy of attention than the very remarkable homomorphisms existing between the very humble rhizopodous foraminifera,

and certain members of the highest class of invertebrata. The foraminifera form the lowest group of the sub-kingdom protozoa, being only raised above the gelatinous Amœba by the possession of a calcareous investment, perforated with numerous foramina, (whence their name,) through which the gelatinous body of the creature, or sarcode, is thrust in the form of long threads, or pseudopodia, whence their name of rhizopods. The calcareous investment is divided into segments or thalami, variously arranged, which communicate with one another by minute pores. But this calcareous investment assumes such beautiful forms, and so closely imitates those of the highest shelled mollusks, that, misled by the external resemblance, these lowly organised creatures were, until 1834, classed by D'Orbigny, with cephalopods. In that year, Ehrenberg reduced them to the level of Flustræ, then regarded as polyps, under the name of Bryozoa; and thus there was the curious spectacle of two groups of animals arranged together, both in their wrong position, one of which was destined to take a place in the highest invertebrate sub-kingdom, and the other in the lowest. It was Professor Williamson, who in 1848, first published the fact of their affinities with the sponges; since which time, they have been studied in a better light, and their correct position assigned to them among the rhizopods.

The majority of these remarkable little organisms go to form the section Helicoidea of Schultze, and they bear so great a resemblance in form to the tetrabranchiate division of cephalopodous mollusca, of which the nautilus is the type, that the only difficulty is to select from the examples. Few, however, will bear a closer comparison with them than Nummulina planulata, Nonionina barleeana, Peneroplis planatus, and Geoponus stella-borealis. But although a vast number assume this form, many other of the higher molluscs have their homomorphs among them. Thus the Spirulina perforata,

and S. foliacea closely resemble the freshwater Planorbis: the genus Marginula most strikingly imitates the terrestrial Megaspira; the elegant Bulimina pupoides is the counterpart of the spiny Melania setosa; Polymorphina lactea, (var. fistulosa,) bears a great resemblance to the well-known stromb, Pteroceras aurantiacum; Cristellaria is capped by the British Pileopsis ungarica; and Patellina corrugata by the genus Patella. Nor are the mollusca alone represented by the foraminifera, for the remarkable acalephs, Stephanomia imbricata (Q. & G.) and Protomedea lutea, have their homomorphs in the species of Textilaria.

There is, however, another class of homomorphisms which are exceedingly curious, and which I cannot pass over in silence. I refer to the recurrent forms which make their appearance in larval stages of the development of various animals. The invertebrate sub-kingdoms, in the case of very numerous species undergo certain metamorphoses before acquiring the perfect form which they are ultimately destined to assume; and these larval stages differ so much in appearance from the perfect animal, that from a misapprehension of their nature, they have not unfrequently been located in other divisions of the animal kingdom. Among vertebrated animals the only order which undergoes a true metamorphosis is the amphibia, such as the frog and salamander. The larvæ of the tailless and tailed amphibia are at first alike in form, provided with external gills and tail, and unprovided with legs. In the anourous amphibia, the tail disappears, and a frog is the result, in the salamander the tail remains. But not only is this tadpole form characteristic of the amphibia, but it was first observed by Sir J. G. Dalyell,* that the tunicated ascidians, both solitary and compound, pass through a tadpole form, and are then locomotive by means of a

* Edin. New Philosophical Journal, 1839.

vibratile tail, which they ultimately cast off when they assume their permanent fixed condition.

The only group of gasteropodous mollusca which undergoes metamorphosis is the Nudibranchiata, and these are first hatched as nautilines, bearing a great resemblance through their shell to the cephalopods; while like the pteropods they swim actively about by means of large lateral ciliated lobes, which afterwards become the epipodium. The larval forms of those decapodous crustacea in which a metamorphosis is observed to take place are so remarkably characteristic, that although they were once supposed to constitute distinct genera, they were never confounded with other species; but in the cirrhiped genus Balanus, the larval form has, as Mr. Gosse observes, "exactly the figure, appearance, and character of the young of the common Cyclops (an entomostracon,) so that you would, without hesitation, if you knew nothing of their parentage, assign them to that well-known genus."* Among insects, the larva and pupa forms of several orders are universally familiar, and the general resemblance of the former to annelids has been remarked by every one. With regard to the pupæ, indeed, especially of the lepidoptera, so great is the homomorphism existing between them and certain shells of molluscs, that a genus of pulmobranch helices has been established under the name of pupa, of which, Pupa chrysalis is perhaps the best example.

The habit of inhabiting cases, adopted by the larvæ of some insects, causes them to bear a considerable analogical resemblance to tubicolous annelids; as for instance, between such caddis worms (or larvæ of phryganeæ,) as form cases of sand, and the Sabella alveolaria; while those which collect together freshwater shells to form their habitations, may be compared to the Terebella medusa, among annelids.† But I must not

* Evenings with the Microscope, p. 238.

† A curious instance of an analogous habit is afforded by Trochus agglutinans.

pursue this subject, and will dismiss it with one or two more examples; thus, the earliest form assumed by the young of the Tubularia indivisa and Medusæ, is called a Planula, from its close resemblance to the turbellarian annelids known as Planariæ; and the polypiform stage of the so-called alternate generation of the acalephæ, (of which *Hydra tuba* is an example,) is the counterpart of the perfect condition of those polyps of which Hydra is a genus.

But one more category of recurrent forms will I allude to, those, namely, which reproduce special parts of more than one animal, and result in certain figures which we should be inclined to call *composite*. In his inimitable Epistle to the Pisos, Horace says,—

"Humano capiti cervicem pictor equinam," &c.

"If a painter were to join a human head to a horse's neck, or a fish's tail to the body of a beautiful woman, would you not laugh at him?" Yet spite of Horace, and under the name of Art, monsters are produced no better amalgamated, and which it must be confessed are more artificial than artful.*

Other such curious analogies may be found both among the vertebrate and invertebrate animals; for example, between the gnat (Culex pipiens,) and the oceanic snail, (Janthina fragilis,) both of which form a raft for their eggs, by means of which these delicate structures are preserved. In the case of the former the eggs are glued together at the moment of extrusion; in the latter they are fastened to the under side of a peculiar apparatus of air cells. An example taken from the vertebrata is afforded by the habit of certain opossums with incomplete marsupial pouches, such as Merian's opossum (Didelphis dorsigera,) which is fain to carry all its young upon its back with their tails all twisted round the common maternal tail; and an analogous dorsigerous habit exists in the Surinam toad (Pipa monstrosa,) of Bufo dorsiger of Latreille, which carries its young for 82 days in pits upon its back, until at the end of that time they are fully developed.

* I cannot help referring here to an admirable illustration of the principles which I shall presently endeavour to lay down with regard to the adaptation of forms, which occurs in Ruskin's "Modern Painters" (vol. iii. p. 106,) where the author compares a piece of true grotesque from the Lombardo-Gothic with one of false grotesque from classical (Roman) architecture. In these sculptures the workmen have combined a lion and an eagle; in the false griffin they have been fitted together by line and rule in the most *ornamental* manner; in the true griffin the most essential parts of the two animals are thoughtfully and skilfully combined, and the result is "not merely a bit of lion and a bit of eagle, but whole lion incorporated with whole eagle." p. 108.

But that which the Horatian precept condemns in Art as only worthy of derision, Nature effects in such a masterly manner as not only to excite our curiosity but to command our admiration. Nature joins together in a wondrous manner the bill of a duck with the body of a mole (Ornithorhynchus); the horns of a stag with the head of a beetle (Lucanus); places a fish's head upon a reptile (Chamæleon), a horse's head upon a fish (Hippocampus), a bird's head upon a mollusk (Bugula); and provides a fish with hands (Malthe.) She even combines the body of a lizard, the head of a fish, the prehensile tail of a new-world monkey, the tongue of a wryneck, eyes which are only found elsewhere in the telescope carp (Cyprinus buphthalmus), and the feet of a woodpecker; and from this curious compound springs the chamæleon, a creature as perfectly adapted to its requirements and mode of life as the most normal organism or the most graceful animal.

Seeing then that we meet with so many forms recurring in widely separated groups, the question now arises, in what light are we to regard them? Must we look upon the lower as dawning anticipations of higher and more perfect forms? or must we, on the contrary, regard the higher as fashioned upon an inferior and degraded type? This is a question which in a general way it is not difficult to answer; although the questions which arise out of it are not so easily disposed of. First, let us enquire what we are to understand as a degraded type. There are grades in organization, from man downwards, as everyone admits. Vertebrated animals are more complex and more highly organized than invertebrate. Mammalia are constructed upon a higher type than birds, birds than reptiles, and these again than fishes. Their whole circulatory apparatus, materially affecting every part of the organization, proves this. Again, the monkey is more highly organized than the mole, the mole than the opossum, and the opossum than the echidna; the cerebral system, no less than the generative apparatus, is

proof of this. Granting, then, a scale of *organization*, may we not also claim in a general way similar gradations for organic *form*? The animal form is as superior to the vegetable form as are the complex functions of which it is the medium in the one to the simply vegetative functions which are required for the other. The vertebrate form consisting of an axis and diverging appendages is as superior to the invertebrate as are the functions of locomotion, &c., in the former superior as a class to those in the latter. Again, the mammalian type of form, adapted to walk or leap, to traverse the earth's surface with the greatest ease and advantage, is superior, as a type, to that of birds whose home is the aerial medium, or of fishes whose movements are strictly confined to the water. And no one will question that the highest type of all is the *human*, whether we regard form *or* organization; while it is only approached in form by that order, which though far below, stands next in point of organization, viz., the quadrumana. If this is granted, then it follows that there is to a great extent a graduated type of *form* as well as of *organization*.

Now, although we have found that in nearly every class and order certain wide departures from the typical form are met with, nevertheless it will be observed that a certain form is characteristic of a certain group. If therefore the aberrant form is homomorphic with some type of form placed far above it in the scale of organization, (which on the whole may be regarded as agreeing with that of form), then we may consider it as *anticipating higher forms*. Thus the very dawn of animal life, as it were, represented by the rhizopod forms, known as foraminifera, anticipate the greatly superior class of mollusca; and even the symmetrical shapes of members of the highest order of invertebrate animals, viz., the testaceous cephalopods. So also the insecta anticipate, in their winged forms, the highly organized class of birds.

But instances of degradation of typical form are far more common; thus, the bats descend to the form of a lower vertebrate class—the pangolins to the reptilia—and the cetaceous mammals assume a still inferior piscine form. The ophidian order of reptiles quit the reptilian, and even the vertebrate type, for still lower resemblances, assuming the general vermiform shape which is the typical form of the invertebrate annelidans. The polyzoan molluscoids are degraded to the morphism of the hydroid zoophytes, and these again to the still lower type of vegetable forms.

The same differences may be observed within the limits of a class;—thus, the gyrencephalous Hyrax descends to the typical form of the lissencephalous rodents, (to use the admirable classification of Professor Owen;) while on the other hand, the lissencephalous Opossum (Dasyurus ursinus) ascends to the high morphic position of the gyrencephalous Bear.

Thus it is evident that no general law of anticipation of higher, or of degradation to lower forms, can be laid down; and even the assumed law of the general agreement of form with organization, it must be confessed, cannot be shown to be unexceptionable.

Since, then, no regular system can be detected in the recurrence of forms, which agrees with an ascending or descending type of organization,—and by means of which we may satisfactorily account for homomorphism,—it becomes necessary to make an appeal to final causes. In a former passage I have alluded to the connection which exists between form and habits, and in those remarks I produced instances of striking deviations from typical *form*, which were accompanied by no less striking modifications of typical *habits*. Taking, then, this principle as a starting-point, let us see if we cannot discover a clue to the morphic deviations referred to: and in order that we may advance with safety, let us commence with instances of the greatest simplicity, and *pass on from* them to the more complex.

Now, among all the vertebrate classes there are certain general homologies which structurally unite every animal contained within them, however it may differ in external form. In all, the diverging appendages are present under some form or other, except indeed in certain ophidians, in which they are entirely absent. In birds, the modification of the fore extremity is obvious, and in fishes only somewhat less so; but although the relative position of the pectoral and ventral fins is sometimes reversed (as in the perch, for example), still the pectorals are *always* homologous with the fore, and the ventral with the hind limbs of other vertebrata. There is, therefore, a great community of *plan* in vertebrates, with respect to those parts which constitute the elements of external form.

Let us now glance at the media in which they move. Mammalia are, as a class, destined to tread the surface of the earth, birds to fly in the air, and fishes to swim in the sea; but neither is the air nor the sea devoid of mammalian inhabitants; and both land and water, as well as air, afford a home for birds. Reptiles also occupy all three stations; and fishes alone, being essentially water-breathing animals, as well as of a decidedly inferior grade of organization, never quit that element. But in order that a mammal should be adapted to an aquatic existence, it must be fashioned more or less in the form of a fish; an elaborate hand or foot would be useless, and projecting appendages injurious. It is therefore piscine in form, covered with a smooth skin, and differs from a fish only in the position of the tail, which being horizontal instead of vertical, is an index of its air-breathing habits. So also, an aquatic bird has a smooth covering of close-set feathers, an attenuated head, fin-like wings, and feet situated so far back as to answer the purpose of a propelling tail when in the water; and could we see a Penguin in the act of swimming beneath the waves, it would undoubtedly have the aspect of a

fish. Take again the Seals, in which these aquatic habits are not so complete as in the cetaceans, and we find them modified in form to be something intermediate between a fish and a mammal; while an Otter, which is rather terrestrial than aquatic, has its quadrupedal character still less modified—in it, there is the close-set fur, the depressed form, and the webbed feet; but the feet are not fins, nor is the tail.

With regard to flying quadrupeds, it is of course more or less necessary that the upper extremity should form a wing of some kind, which, however different in the homologies of its parts from the wing of a bird, must necessarily bear some general resemblance to it in form. A bat is as purely an aërial animal as is a bird, but its wing not being formed upon the type of that which exists in a true bird, must be inferior; nevertheless it is as truly and completely a *wing* as is the far more perfect, but less bulky, wing of a bird.

Further, if we select a single class, such as the mammalia, and bear in mind the same principle, we shall find it lead to the same results. Some quadrupeds of each order are arboreal, some terrestrial, and others subterranean; some are carnivorous, some insectivorous, and some frugivorous; some are nocturnal, some diurnal, and some crepuscular. If, now, an animal belonging to one order, is, like an animal of a different order, insectivorous, the former probably bears some remote analogy to the latter by virtue of that fact;—if the animals of two different orders are not only *both* insectivorous, but also crepuscular, for example, the probability of their resemblance is increased; but if the two are insectivorous, crepuscular, *and* subterranean, then the great agreement of their habits must be accompanied by a considerable approximation of form.

Perhaps there are no facts in the natural history of animals which are simpler, or with which we are more familiarly acquainted in a general way, than the broad characteristics which differentiate the habits and modes of life of quadrupeds,

birds, and fishes; and on the other hand, the aberrant forms which are assumed by aquatic mammals and birds, and by aërial quadrupeds, and the homomorphism of these aberrant forms with those of the classes of vertebrata which they most nearly approach in their habits and modes of life, are highly important questions, which thus admit of elucidation with a degree of probability commensurate with this exactness of our knowledge of those habits. The kind of homomorphism which obtains between members of a class (such as among the various orders of the mammalia) requires a different kind of knowledge, viz., not a general acquaintance with broad facts, but a special familiarity with individual habits. Now, such a special knowledge is by no means always possessed, or even easily attainable; but when it is so, it is found that the greater the agreement of habit and modes of life between any two animals of distinct orders, the more striking is the homomorphism which exists between them. Of this proposition, several illustrations have already been given.

Taking now our stand upon these facts, and carrying the principle which I have laid down into the invertebrate division of animals, the first thing which strikes us is the comparative artificiality of some of the resemblances which have been mentioned as existing between them and the vertebrate sub-kingdom. The habits of a mollusc and a fish can scarcely be compared, still less can those of a tunicate and a reptile, or of an infusory and a quadruped; and yet we perceive between them close resemblances of form; but between a worm and a siphonops, or between an insect and a bird, we can readily argue a community, because we at once estimate the narrow limits in the one case, and the wide extent in the other, of their analogical functions. It would be highly unphilosophical to suppose that these close resemblances were the effect of accident, and still more so to say that they result from accident in one case, and from profound design in another.

The homomorphisms existing between the vertebrata and invertebrata are not numerous; indeed, as might be expected in animals so widely separated, they are rare, and usually imperfect. I confess they present the greatest difficulty. And yet where knowledge of habit assists us, the difficulty to a great extent vanishes. There is no class of invertebrata more familiarly known than the insects, and there are no clearer homomorphisms between these great sub-kingdoms than those between insects and birds; and who is there that does not perceive that the forms assumed by insects are as much the necessity of their habits—and that in habit, as in form, they assimilate to birds, just as a bat does, or as a whale does to a fish.

Again, how little do we know of the habits of the invertebrate classes generally. The majority of them are marine; and it is only quite recently that they have even been *seen*, except through the medium of pictures, by the majority of persons. We are not on terms of familiarity with *them*, as we are with quadrupeds and birds; and seeing that our comprehension of their homomorphism is in direct ratio to our knowledge of their habits and modes of life, it is not a matter of surprise that we should be unable to penetrate the mystery of the similarity between the Foraminifera and the Mollusca, or between the Polyps and the Polypine Infusories. For here, again, the explanation of their homomorphisms is measured by the amount of our knowledge. We know why a Bombylius resembles a Bombus, or a Teredo a Sabella, having some acquaintance with the similar habits of each, and seeing a degree of similarity between them. We know why a caddis-worm resembles a tubiculous annelid, and this again a tube-inhabiting rotifer; it is the common habit of forming a tube for their otherwise unprotected body which assimilates them. But we know not why a Chiton resembles an Aphrodite, because we are equally ignorant of the habits of either.

Let me now, in application of the foregoing principles, throw out some suggestions in relation to the most striking instance of homomorphism which occurs, perhaps, in the animal kingdom,—viz., that existing between the polyzoan molluscoids and the hydroid polyps. In both these widely separated groups we have certain compound forms, made up of numerous membranous or calcareous cells, upon a common axis or stem, which branches in a plant-like manner, each cell being the habitation of a distinct animal. These are their homomorphic characters ; now let me state what are the special characters of each group. First, hydroid polyps :—mouth with filiform, simple tentacula ; stomach excavated in the cellular substance of the body ; no distinct muscular apparatus ; body contractile in all its parts—gemmiparous externally. Second, polyzoa :—body not contractile, symmetrical ; mouth and anus separate ; gemmiparous and oviparous. It therefore appears that the polyzoa are minute molluscs, differing in all their homologies from polyps. Let us next inquire of which group the polyzoary form is typical. Clearly not of the mollusca, which are for the most part of very different form ; and equally clearly it *is* typical of the polyps, in which class it assists their analogy with vegetable forms. The polyzoarian form, then, is aberrant from the molluscan, and typical of the hydroid polyps. *Why* this form is the best adapted for the life of polyps I am not required to prove, but only why (that being granted) it is also the best form for the polyzoa. Next let us enquire what differences exist in the form of the animals themselves. In the polyp there is a gelatinous substance hollowed out into a stomach, a single aperture serving the purposes of taking in food, and passing out rejectamenta and ova—this common outlet being surrounded with a circlet of gelatinous contractile tentacles, armed with nettling capsules. But the molluscoid has an œsophagus, stomach, gizzard, intestine, distinct anus, besides a liver and nervous system.

In none of these particulars has it any relationship with polyzoa; but the mouth is surrounded with a circlet of tentacles, not indeed like those of the polyps, simple and contractile, but uncontractile and covered with vibratile cilia. They are probably the homologues of the labial palpi of other molluscs. This circlet of tentacles, then, is the *great point of resemblance* between molluscoids and polyps; in the latter the common arrangement—in the former, arising as it were from an accident or variety of organization. But yet, is it not easy to perceive that the common possession of tentacles exhibited by polyps and polyzoa implies a very great similarity, nay, almost *identity*, in one of the most important *habits*, namely the mode of procuring food?

Having so far established a community of habit between them, let us next refer to the grand organic distinction which is implied in the widely different form of the digestive apparatus. In the polyps, the rejectamenta being passed out by the mouth, such animals are well fitted, doubtless, for living in cells with a single aperture; the mollusca, however, have an intestinal canal, and anal aperture besides. But it must be borne in mind that the anus in the polyzoa does not open at the extremity of the body opposite the mouth, as in the archetypal mollusc; but by a sudden bend of the intestine, the anal aperture is brought into the closest possible proximity to the mouth; so that, although separate, they both open at the same spot; and let it not be supposed that this diminishes aught from their position as molluscs, for in the highest molluscs, viz., the cephalopods, the same thing takes place in a somewhat less degree. Here again is a structure which implies great *community of general habit*. Lastly, there is another most important community of habit between the polyps and polyzoa, viz., that although the mollusca, as a class, are oviparous, the polyzoan molluscs are, in addition, *gemmiparous*, like the polyps; and this power is evidently the

secret of the production of those compound forms which the polyzoa present in common with polyps. Hence we see that with scarce anything in common, except superficial characters, the habits of polyzoa and polyps are nearly identical; and to this fact I would look for an explanation of their identity of form.

In conclusion: Lord Bacon has somewhere remarked that experiments and observations are of two kinds, viz., first *of fruit*, and second, *of light*—by which he meant that some led directly to some plain and definite ends, which amply repaid the labour bestowed upon them; while others, by no means to be despised, yet were not so obviously accompanied by actual fruit. Far be it from me to raise homomorphism to the rank of homology; I have endeavoured throughout to place them in strong contrast; and although I do not wish to forego all claim to fruit from these observations, I am willing to allow them rather to belong to the second category. But I cannot sympathize with those who would taboo such curious questions, simply because some others lead to more important results.* Everything in Nature is worthy of investigation, and although I may not have succeeded in fully tracing out the law of order which probably exists in these homomorphisms, still I have by the enquiry improved my own knowledge of Nature, and have given, I trust, an insight into the creative workings of the Almighty, which cannot fail to increase the desire to be more closely acquainted with them. Surely, human works fall infinitely short of the surpassing interest which appertains to those of the Great Artificer; and human history is but a line in the great scroll of the universe, which has been inscribed from the beginning with the works of the Creator. Let no one presume ignorantly to contemn, or

* For an example of such reasoning, see Bain "on the Senses and Intellect," p. 499, where the writer of that generally excellent work argues rather as the disciple of a severe school of logic, than as a loving and humble follower of Nature.

conceitedly to overlook the stupendous work of creation, of which man is the keystone and the crown: but if ever he be tempted to assert his superiority by underrating the matchless perfection of Nature, let him humble himself in the dust, when he remembers that the God who formed *him* looked upon all the things which he had made, "and behold they were very good."

THIRTEENTH ORDINARY MEETING.

ROYAL INSTITUTION, 2nd April, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The Chairman alluded to the interview of a deputation from several learned societies in town, with William Brown, Esq. and the Town Council, relative to a contemplated plan of setting apart a portion of the Free Public Museum for the display of models and scientific objects applied to purposes of utility.

The Chairman also drew attention to the development of medusæ, from *Hydra tuba* in the aquarium under Mr. Moore's direction in the Derby Museum.

Mr. JAMES YATES, F.R.S., corresponding member, attended the meeting, and spoke on the question of a decimal system of measures, time, and money, referring to Mr. Statter's plan of employing the equatorial circumference of the earth instead of its polar axis, as the basis of his unit.

The Secretary exhibited and described a working model of Newcomb and Lovell's engine, for using water as a motive power. The chief peculiarity was the adaptation of a donkey

engine to the cylinder, so that with but one cylinder the work of two could be obtained. The small steamer exhibited had been tried a few days before upon the lake in the Prince's Park, and made fair speed.

The following Paper was then read —

ON THE RELATION BETWEEN ATMOSPHERIC PERTURBATIONS & EXPLOSIONS OF FIRE-DAMP IN COAL MINES.

By THOMAS DOBSON, Esq., B.A.Cantab.

The inquests which follow fatal explosions in coal mines seldom elicit much information respecting the ultimate causes of these disasters. The proximate cause even is in general left to conjecture. Some miner in whose "board" the "foul air" appears to have first "fired," is supposed to have been working at the time with a naked light. But as it is notorious that miners run this risk habitually, either from carelessness, or from a dislike of the faint glimmering given by a locked Davy-lamp, it would seem [illegible]nable on such occasions to make the investigation bear more directly on the question, "how did it happen that the atmosphere of the mine was in such an exceptional state as to explode without any *unusual* exposure of lights?"

In many dangerous mines Davy lamps are only used in the "pillar" workings, which lie in, or near to the "goaves," or abandoned wastes,—reservoirs of many acres in extent, where the carburetted hydrogen gas accumulates undisturbed; while naked candles are always used in working the new coal. This is the ordinary state of things, and the probability of an explosion occurring soon after any extraordinary flow of gas

into the mine is evident, when it is considered that the Davy lamp itself is by no means perfectly safe, and that the light inflammable gas may easily travel gradually along the roof of the passages of the mine from the goaf to the parts where naked lights are being used.

There is only too much reason to fear that at such inquests the viewers and inferior officers of the mine, seeing their professional reputation at stake, unite in defeating the enquiry by withholding information, and that the owners are not unwilling tacitly to sanction a line of conduct which tends to protect them from the consequences of an unfavourable verdict.

One of the last things to be admitted by the manager of an exploded mine at an inquest, would be the direct agency of atmospheric disturbances in causing the accident; for as such disturbances may be foreseen, and their consequences in mines prevented, the neglect implied by such an admission might help to lead to an adverse verdict, and to a compulsory provision for the widows and fatherless children of the men killed by the explosion.

Nevertheless, the belief that atmospheric fluctuations are in some manner principally concerned in causing these disasters has long prevailed among the most intelligent mining agents, viewers, and practical miners, as is abundantly shown by the evidence given before the several Committees of both Houses of Parliament appointed from time to time to enquire into the subject of accidents in coal mines.*

* The following were quoted from authentic records. (Blue Book):—

In 1835, *A. Winship*, wasteman in Lord Durham's mines, says—"we generally think that the hydrogen gas is more quick and severe when *the wind is from the south.*

Nicholas Wood, colliery viewer to Lord Ravensworth and Co., says—"a fall in the barometer occasions a considerable change in the quantity of gas discharged; if the barometer rises, the gas then withdraws to the old workings, and does not come out in such quantities. Hydrogen gas exists in the pores of the coal in a state of high compression, if the external pressure is removed, it issues in greater quantities, and we accordingly find a very much greater discharge by the fall of the barometer."

The evidence of *George Stephenson* is very clear on this point, he says—"I believe that accidents of this kind, of any extent, very rarely happen except when

The evidence sufficed to shew that the supposition of an intimate relation between fluctuations of atmospheric temperature and pressure and explosions of fire-damp in coal-mines

the barometer stands low; such accidents are frequently the result of the excessive quantity of gas thrown into the mine by the diminished pressure of the surrounding atmosphere. I know that when the pressure is fourteen pounds on the square inch, a very large quantity of gas comes off, and when it is fifteen pounds, very little indeed. It was a common observation of the wastemen that the explosion was caused by the *south wind*, which occasions a low barometer. In many mines, the hewers, on turning out, and finding a warm south-west wind, decline proceeding to work."

In 1849, *G. Whieldon*, high sheriff of Worcestershire, says—"when my agents come to tell me that such and such pits are not at work, and that the candle will not burn, I have said, what is the cause? and thy have said, the wind is in such a point."

J. Hutchinson, M.D., of Newcastle-on-Tyne, states that all the furnace-men that he has ever asked, and likewise the miners have always complained of *south*, and *south-west winds* affecting the ventilation.

J. T. Woodhouse, colliery viewer in the Midland Counties, states that explosions occur particularly when the wind is *one or two points east of south.*

E. S. Barber, mining agent over collieries in South Wales, says—"it is generally understood that when the barometer is low, the mine is in a dangerous state. Invariably so.

David Swallow, miner, of Bolton, Lancashire, has observed particularly that the effect of the pressure of the atmosphere upon the escape of gas is very obvious to those who are employed in the mine.

Martin Jude, miner, from Northumberland, states that explosions generally occur during a *south-west wind.*

Benjamin Biram, agent, and viewer to Lord Fitzwilliam, speaking of an explosion at Darley Main Colliery, in Yorkshire, in 1849, by which 75 persons lost their lives, says—"I believe the accident partly arose from the state of the air at the time, there having been a considerable wind the day before. I believe that a considerable fall in the barometer has a very great effect in causing a discharge of carburetted hydrogen in coal mines, very frequently.

T. J. Taylor, colliery viewer, Northumberland, says—"on the fall in the barometer, I have heard "blowers" begin to hiss and howl in a mine, so that it was possible to tell at once, without consulting the barometer, that the pressure of the atmosphere had diminished.

J. Roberts, colliery owner, in Dean Forest, says—"the carbonic acid gas (or choke-damp of miners,) in those mines, generally occurs as *the wind shifts.*

The Report of the South Shields Committee in 1852, contains the following Letter from the Proprietor of Jarrow Colliery, to one of the Committee.

"Jarrow Colliery Office, 24th September, 1839.

"DEAR SIR,

"On the 1st September, I find the barometer stood at 28.81 "inches. The master wasteman's account of the state of the air in Jarrow Pit on "that day, is, 'that it was so bad that the *gas came to the shaft.*' On the day of "the *great storm*, (7th January, 1839,) my barometer was down to 27.48 inches; "and the wasteman's account is 'that he seldom, if ever, knew a pit to be in such "a state.' The gas came to the shaft in the Bensham, and having made its "appearance in the Bensham engine chimney, it was found necessary to ex-"tinguish the fire. The wasteman says that 'the glass does not fall two degrees "without a change being perceptible below.' I have ever impressed on the

is countenanced by the experience of working miners, viewers, and others conversant with the nature of explosive mines.

I shall now endeavour to shew that our knowledge of the laws of atmospheric perturbations will account very satisfactorily for the prevailing belief that explosions occur chiefly when the wind blows from the south-east, south, and south-west; when the wind is shifting, and the mercury is falling rapidly in the barometer.

It is now well ascertained that all the great perturbations of atmospheric pressure and temperature along the western coasts of Europe are the immediate effects of passing cyclones, or revolving storms, which sweep across the North Atlantic Ocean towards Europe in a north-easterly direction. The effect of such a cyclone on a number of barometers placed at considerable intervals along a meridian through Britain and France, is found to be precisely the same as would be produced by an immense circular eddy in the atmosphere, the mercury falling lowest just below the centre of the eddy, where the greatest quantity of air has been displaced by centrifugal action, and the depression of the mercury continually decreasing as the stations of observation approximate to the margin of the eddy.

Suppose a cyclone to pass over the mean meridian S.N. of

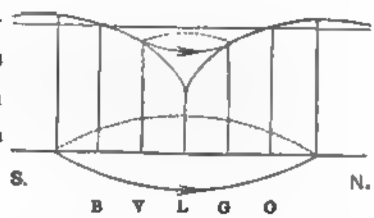
"officers to pay attention to the fall and rise of the mercury, and I am often told "it is a good guide. (Signed) T. DREWETT BROWN."

In 1846, *Dr. Lyon Playfair* says—"the escape of fire-damp is generally influenced by the barometrical state of the atmosphere, especially when much of the gas has become accumulated in the wastes or "goaves." This is more or less experienced in all pits, but one striking case was pointed out to us, by Mr. Jobling, head-viewer of Jarrow pit. In a pit of which he is the viewer, the gas issues from cracks in the roof of the seam, and in low states of the barometer, is evolved in considerable quantity. When the barometer is high instead of this issue of gas, there is a sensible current of air which enters into the cracks. When the inward current takes place, the pit is worked with naked candles, but when the evolution of fire-damp commences, Davy's are employed."

In 1849, *Dr. Playfair* remarks that there is no means in the furnace ventilation of *adjusting* the supply of air—for example, of causing a much greater circulation of air when required by particular circumstances.

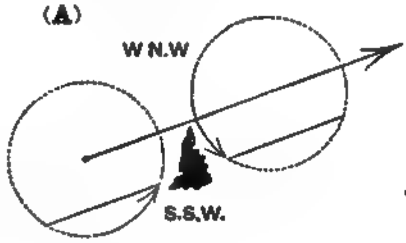
This last statement is important, as shewing that there is no means of readily compensating the effect of a sudden and unusually large issue of inflammable gas into the frequented parts of a coal-mine.—T. D.

the group of stations Bordeaux, Versailles, London, Glasgow, and the Orkney Islands. The observations at these places shew that the mercury falls continuously in the barometer at all the stations during the passage of the first half of the cyclone, and rises during the passage of the other half. The maximum depressions at the several stations occur almost simultaneously, but vary in extent. If the centre of the cyclone pass over London, the mercury will fall lowest there, and the maximum local depressions at the other stations will decrease gradually in both directions from London, as is shown in the diagram.



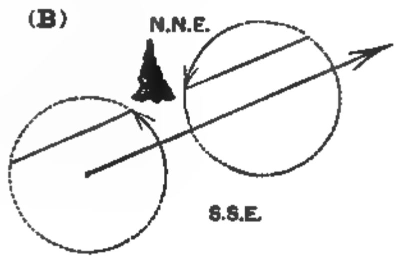
The direction of the wind and the order of the successive shifts of wind at each station, are always found to be such as would be caused by the passage to the north-eastward of an aërial eddy, or whirlwind of immense diameter, revolving in the opposite direction to that in which the hands of a watch move.

(A)



Hence, when the central track of a cyclone lies to the north of Great Britain, as in the diagram (A) the wind is at first about S.S.W., veering gradually to W., and finally to about N.N.W. But when this track lies to the south of Great Britain, as in the diagram (B), the storm begins at about S.S.E., veering through E. to N.N.E., or N.

(B)



The action of a cyclone on the thermometer in Great Britain is in general the reverse of that on the barometer. In the case (A), the most frequent here, the warm south-westerly winds cause the mercury to rise in the thermometer, while it is falling in the barometer from the rapid decrease of atmospheric pressure. But as soon as the wind shifts through W. to N.W. the cold northerly wind depresses the mercury in the thermometer, at the same time that the increasing atmospheric pressure is raising it in the barometer.

In the rarer case (B) the cold easterly winds produce comparatively little effect on the thermometer. During the autumnal and winter months, cyclones appear to be animated with their greatest velocity of rotation, and consequently with their greatest centrifugal action, evinced respectively by destructive storms of wind and extreme fluctuations of the mercury in the barometer. At other seasons their rotatory motion is comparatively slow, and the winds, therefore, not of unusual violence; but their cyclonic nature may be always unmistakeably recognised by their peculiar action on the barometer and thermometer; and by the order of succession of the shifts of wind. The southern margin of a slowly-revolving cyclone often produces a very marked elevation of temperature, although the accompanying depression of the mercury in the barometer is slight, and the winds may not be strong.

Such being the nature of every great atmospheric paroxysm here, the manner in which it may tend to create an unusual and dangerous accumulation of inflammable gas in European coal-mines is obvious. Unfortunately both for the owners and miners, the approach of a cyclone to the British Isles generally produces simultaneously both the atmospheric conditions which favour this result.

These conditions are characterised, both by *a rapid fall of the mercury in the barometer*, indicating diminished atmospheric pressure, and therefore a more active flow of gas

into the passages of the mine—as well from the innumerable fissures in the face of the whole coal, from isolated "blowers," as from the abandoned "goafs," or old workings; *and by a rise of the mercury in the thermometer*, indicating an increased temperature of the external atmosphere, and therefore a slackened ventilation, by which the gas is left to accumulate below.

The danger of explosion will be much increased if the sudden barometrical depression should immediately follow a considerable interval of calm weather, and therefore of great atmospheric pressure, which increases the elastic force of the explosive elements pent up in the "goaf," by checking the usual escape of gas into the mine.

Again, it is well known that the ventilation of a mine is more brisk in winter than in summer, on cold days than on hot days, and in the night than in the day. The gas lodged in the mine during a hot day may be carried off by the accelerated current of air during the succeeding cool night; but when the southerly margin of a slowly-progressing cyclone passes over Great Britain, three or four hot days and warm nights may come all together, and it is needless to say that this also will be a time of especial danger.

In the application of these principles to the examination of the meteorological circumstances connected with any particular explosion, it must be borne in mind that we are more concerned with the state of the atmosphere during the days and nights immediately preceding the explosion, than with its state on the very day of the accident. A passing cyclone may have liberated the gases imprisoned in the "goaf," and the slackened ventilation have failed to dilute the air below the point of explosion, for several days before the foul air is fired in some remote "board."

The preceding sketch of the nature of European cyclones is in strict agreement with the well-known conclusions arrived

at by Mr. Redfield and Sir Wm. Reid respecting the storms of the North Atlantic Ocean; and might have been inferred from their results. But in order to avoid unnecessary assumptions, and to determine independently the laws of action of a cyclone on the barometer and thermometer in Great Britain, I have made a laborious and careful examination of all the fluctuations of aërial pressure and temperature along the western sea-board of Europe, from the year 1847 to the year 1856, inclusive. The materials for this investigation were kindly supplied to me at the rooms of the French Meteorological Society in Paris, and at those of the British Meteorological Society, by the respective Secretaries of these institutions.

On a horizontal scale of one-tenth of an inch to a day I have constructed for each year the meteorological curves at two or three stations, differing considerably in latitude; the barometrical curve, from two or more daily readings, and the curves of maximum and minimum daily temperature, on a scale of 20° F. to an inch.

The observations at Stonyhurst College, Lancashire, and at Wakefield Prison, Yorkshire, being taken at intervals of six hours continuously, night and day, are good standards of comparison.

For the greater part of 1855 and 1856, I have drawn the simultaneous curves from daily observations at twelve stations of the British Meteorological Society, extending from Teignmouth, in Devonshire, to Elgin, in Scotland. To these are added the observations at the Orkney Islands, from the Philosophical Magazine. The direction and force of the wind were only copied in the case of well-marked aërial perturbations. This comprehensive series of graphic records of all the fluctuations of aërial density and temperature during ten consecutive years, constructed with care from the best available data, is the basis of my conclusions respecting British storms.

These curves prove that all the great non-periodic disturbances of our atmosphere are the effects of cyclones, of more or less violence; that the action of cyclones is remarkably uniform, and their extent enormous in comparison with the area of Great Britain.

In a report on the relation between explosion in coal-mines and revolving storms, published among the reports of the British Association for the year 1855, I have compared the dates of 74 explosions in 1852 with the meteorological curves for that year. I have since examined the meteorological conditions of the atmosphere connected with every fatal explosion on record, from the year 1757 to the end of 1856, amounting in all to about 750, and now proceed to give two or three examples of the mode in which this examination has been conducted, and shall take for this purpose examples which illustrate the nature of British cyclones, as well as shew their relation to coal mine explosions.

Since fatal explosions only are registered by the Government Inspectors of mines, and there is no record kept of the numerous cases where mines are surcharged with gas and no explosion ensues, it is clear that a large portion of the evidence connected with my investigation is not available.

I shall be glad if my researches should have the effect of inducing managers of coal mines to study meteorology, and to pay more attention to the unfailing premonitory symptoms of coming danger, which are shewn by the barometer or thermometer, or, in many cases, by both.

The barometric indications for 1850, (see plate VII.) shew that several small cyclones passed over Great Britain between the 29th of October and the 12th of November; producing during all that interval a remarkably high temperature. The cyclone of the 3rd and 4th November was "a smart hurricane" at Liverpool, where the ships "Providence" and "Arcturus" were wrecked, and twenty-five lives lost. Near Holyhead two

vessels were lost, and at Southport one. All over England, chimneys, walls, trees, &c., were damaged. On the 11th November, there was an explosion in the Houghton pit, Newbottle, Northumberland, by which twenty-six lives were lost. It was stated at the inquest that "the men had been apprehensive for more than a week."

The central barometric depressions of two well-marked cyclones occur on the 19th and 24th, causing another period of about ten days of elevated temperature and greatly diminished atmospheric pressure. On the 19th the barometric depressions decrease both towards Scotland and France, shewing that the centre of the cyclone passed over England. This produced a great storm of wind both in France and Great Britaiu. A fatal explosion at the Emroyd pit, Wakefield, on the 19th, and another at Dawley, Shropshire, on the 25th, almost coincide with the times of least atmospheric pressure. Another explosion at the Victoria pit, Wakefield, on the 28th, was probably induced by this storm.

The passage of the warm south-western margin of a cyclone in the beginning of December, is recognized faintly by the barometer, but very distinctly by the thermometer. The temperature in Lancashire, from the 2nd to the 6th December, throughout both days and nights, is raised at least 20° F. Fatal explosions occurred at Oldham, on the 4th, at Wolverhampton on the 5th, and at St. Helens on the 7th.

The centre of another great cyclone passes on the 15th and 16th. At the Orkneys the winds are S., S.W., and N.W. in succession, and the barometric depression is greatest there. The rise of temperature is most marked at the southern margin,—at Versailles and Bordeaux. In England the barometric depression is nearly an inch-and-a-quarter, and the rise in temperature about 10° during several days and nights. The fatal explosions during the rest of December are immediately related to this cyclone—they occurred at Rowley

Regis, Staffordshire, on the 13th, at Aberdare, on the 14th, at Hindley, on the 17th, and at Wrexham, on the 21st.

The diagram for July, 1853, (see plate VI.) contains the best example I have met with of an extensive summer cyclone—its area having been quite equal to what was supposed by Sir W. Reid to be peculiar to our great winter storms. The local maximum barometric depression takes place simultaneously all the way from Oran, in Algiers, to the Orkneys; and decreases in both directions from England, where its central passage was marked by a great storm of wind, hail, thunder, &c., in which a screw-steamer from the Tyne foundered off Flamborough Head, on the 13th.

At Oran, the wind is westerly; at Versailles it shifts from S.W. to W.S.W. and N.W., and at the Orkneys the successive shifts of wind are E.S.E., E., and N.E. This example deserves the special attention of any one who has still any lingering doubt as to the cyclonic nature of British storms.

The fatal coal mine explosions during the passage of this cyclone, were—on the 14th at Monkwearmouth, where six lives were lost; and *two* on the 16th, at Incehall, Wigan and at Bettws, in Wales.

The diagram for November, 1854, (see plate VI.) contains two well-marked cyclones, of which the first will be known in history as the Balaklava tempest. From the observations at any one station—as at Wakefield—it might be inferred that this cyclone belonged to the class which has its central track to the south of England, for the successive shifts of wind are E.S.E., E., and N.E., and the thermometer is little disturbed. The central barometrical depressions also decrease from the British Channel to the Orkneys. Its easterly course is implied by the winds having been first southerly and then northerly. These inferences have been completely verified by M. Liais, of the Imperial Observatory of Paris, who traced the passage of this storm with great care and accuracy, by

means of an immense number of observations made at stations spread over the whole of Europe, from the British Isles to the Black Sea, and Caspian Sea. Its passage over Britain occupied about six days, from the 12th to the 18th. On the 13th there was a fatal explosion at Dudley, on the 14th one at Cramlington, Northumberland, and the 15th, (the day of minimum atmospheric pressure,) is characterised by three fatal explosions—respectively at Bolton, at Dudley, and at Coalbrookdale, Monmouthshire. On the 16th there was a fatal explosion at Coatbridge, in Scotland.

No more fatal explosions are recorded until the arrival of the central depression of the second cyclone on the 22nd, when one occurs at Wrexham, and another at Burton-on-Trent. Before this cyclone leaves, there is another fatal explosion on the 24th at Kilmarnock, in Scotland, which is the last in the month.

FOURTEENTH ORDINARY MEETING.

Royal Institution, 16th April, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. Brooke, F.S.A., exhibited portions of lead pipe taken from the hot water apparatus in his residence, containing a thick deposit of sulphate of lime. He mentioned that the same kind of accumulation had been found elsewhere in Liverpool, where water, in a boiled state, passed through lead pipes. He also stated that the specimens he exhibited were taken up before the Rivington water had been introduced into Liverpool.

The Chairman announced that Mr. Charlesworth, the eminent naturalist, was present, and would make a communication with respect to certain fossils, a portion of which were then upon the table for examination, and would afterwards be removed to the Free Public Museum, where he was glad to say they would remain.

Mr. Charlesworth having made some observations upon the museums of natural history in provincial institutions, and the errors of their management, recommended the employment of men of science in their arrangements. He then submitted to the meeting a cast of a remarkable group of fossil fish which had been found, it appeared, in the chalk formation at Rochester. He observed that though single specimens were abundant in the chalk, yet this was the only instance known of a group having been found. The appearance of the fishes, their extraordinary perfection, and the almost total absence of any indication of pressure, showed that they could not have been engulphed slowly; and yet to suppose that the process was rapid was contrary to the received scientific views of the chalk deposit. He next brought under notice the humerus of the mammoth (*Elephas primigenius.*) He noticed the extreme rarity of these bones; for whereas the teeth of the mammoth were abundant in many places—not fewer than 2,000 having been raised from an oyster bed in Norfolk—yet only three specimens of the humerus were known to exist in any tolerable preservation. The largest known by Cuvier was three feet four inches in length, but the specimen then in the room, and which was without the epiphysis, was three feet eight inches, yet it was manifestly the bone of a young animal. A specimen in the possession of Miss Gurney was four feet five inches long. The enormous size of an animal of this sort could be imagined, when it was remembered that the specimen must be twenty-seven inches taller than the enormous elephant Chuny, whose skeleton was preserved in the College of Surgeons in

London, and which was the largest known specimen of the elephant. He showed some of the tusks of the mammoth, and also certain remains of the plesiosaurus and ichthyosaurus, as also a tooth (*Carcharodon megalodon*) of an extinct species of shark, which animal, he said, must have been eighty feet long at least.

The following Paper was then read—

ON THE STONY CORALS.

By the Rev. HENRY H. HIGGINS, M.A., President.

Very low in the scale of organised beings, in complexity of structure far inferior to many vegetables, occur the creatures long known as zoophyta or animal plants. In the following paper the term zoophyte is used to denote the whole animal structure, whether simple or compound, including the secreted skeleton or framework, when present.

How far a distinct individuality may be attributed to each of the polyps of a compound zoophyte, is a question which has yet to be decided. A polyp, however may be thus characterised:— "An inarticulate fleshy body nearly cylindrical, having a circular or elliptical summit called the disk, bordered by one or more series of tentacles, and an opening or mouth at the centre of the disk: internally a visceral cavity closed below, no distinct vascular system, an imperfect nervous system or none, and no senses but those of taste and touch."*

It is important to bear in mind that throughout the whole class of zoophytes there is no departure from these essential characters. In a polyp, whether of almost invisible size, or a foot or more in diameter, the body is simply fleshy, having a visceral cavity with one opening only: the arms may be mere

* Dana on Zoophytes.

wart-like excrescenses, or they may be complicated and greatly prolonged, still they are simply tentacles, without a trace of an articulated structure. Polyps may form for their support little horny tubes, a shapeless stony mass, or a framework surpassing in delicacy and symmetry the finest productions of art; yet in each case the work has been done without eyes or any thing resembling hands, so that our admiration may be greatly increased when we behold the marvellous beauty residing in the works of these senseless artificers.

Strictly speaking, however, the corallum, or portion of the zoophyte which remains when the fleshy parts are dried up, whether horny or stony, is not the work of the animal, in any such sense as the honeycomb is of the bee, or even as certain shelly tubes are of some annelides, but rather resembles a skeleton, sometimes wholly internal, sometimes partially external, but always partaking of the vitality of the creature. It is not then the cleverness of the little architects that we are called upon to admire, as in the case of the silkworm or the bee, but rather the prodigality of creative skill displayed in nature, constructing forms so highly complicated and exquisite out of the framework required for the support of such lowly beings as polyps.

Polyps are of two kinds, distinguished by the presence or absence in the visceral cavity of vertical plates or lamellæ. Such as have a tubular form without internal support take their name from the Hydra and are called hydroid polyps; they are mostly small, and if they possess a corallum, it is of a horny character and often very flexible.

The seas of our own island abound with zoophytes of this order, and the species are numerous. If we except the Tubularia few of them are shewy in colour, and even these are without the bright hues of the coral polyps; a deficiency which is more than compensated for by the gracefulness and delicacy of their forms, resembling feathers of the Bird of

Paradise, or wavy tresses of dark auburn hair, as in the instance of a tuft of a species of Plumularia brought to me from the west coast of South America.

Polyps of the other kind derive their name from the membranes or thin plates, which, like the spokes of a wheel divide the visceral cavity into sections; they are called actinoid polyps, and such of them as have eight papillose or warty tentacles belong to the sub-order Alcyonaria.

Among the more remarkable groups of these are the Pennatulidae or sea pens, one species of which is called by fishermen the Cock's-comb, from its resemblance in substance and colour to the wattles of a cock; but in form it is more like a quill with a short thickened plume. Another is the Pavonaria, so called from its likeness to the midrib of a feather from a peacock's tail: all the species are unattached, but when living are found with their lower ends buried in sandy mud, where they probably remain without power of locomotion.

The Alcyonidæ form sponge-like masses frequently lobed or digitate. When the polyps are expanded the whole mass resembles a cluster of delicate flowers with fringed petals: the tropical species are said to line the submarine grottoes of coral reefs with richly-coloured blossoms. These zoophytes have no proper corallum, but contain an abundance of calcareous granules.

The Tubiporidæ include the well-known Tubipora musica, a deep red coral, consisting of parallel tubes rising rank above rank. I have myself seen it forming large rounded masses in comparatively shallow water in the Gulph of Akaba. The polyps are of considerable size and very beautiful, resembling a cluster of pinks.

The remaining family of the Alcyonaria, the Gorgonidæ are readily distinguished by the solid stem secreted by the base or foot of the polyps which reside in a fleshy crust, or

bark, easily separable from the axis. The species are very numerous, and the polyps are described as gorgeous in their colours. The specimens of Gorgonia brought to England, beautiful and graceful as they are in form, give no idea of the surpassing richness of the zoophyte in a living state. In this family occurs the Isis nobilis of Cuvier, the precious coral of the Mediterranean.

We now approach the sub-order Actinaria, in which are found the true stony corals. To distinguish their position amongst zoophytes, we first of all set aside the order of hydroid polyps, which have their internal cavity perfectly simple and tube-like. The second order, Actinoidea, having afforded us a brief glance at the extensive sub-order Alcyonaria, including such polyps as with a rayed internal structure possess eight fringed or warty tentacles, we proceed to the remaining sub-order Actinaria, the most interesting and important of all the groups. The Actinaria are readily known from the Alcyonaria by their smooth tentacles six, twelve, or often many more in number. Moreover it is only in the softer parts of the zoophyte that the Alcyonaria exhibit a rayed structure, whilst in the Actinaria the lamellæ, which like the spokes of a wheel divide the visceral cavity, often secrete calcareous plates enduring long after the polyps themselves have ceased to exist.

In the Actinaria reproduction is either by ovules thrown off from the mouth of the parent polyp, or by budding, both methods being common to most of the species, though rarely, if ever, found in exercise together in the same specimen at the same time. The ovules are dismissed to form fresh colonies, whilst the parent zoophyte increases by the process of budding.

The varieties of form in the stony corals are extremely numerous; we may find simple radiated disks, erect or inverted basins, columns single or in clusters, solid domes hemispherical

or resembling rude hillocks, thin plates even or nodulous, foliaceous expansions, arborescent growths, nearly simple, or highly compound; and very many other forms: all of these may be recognised as the result of certain peculiarities in the coral animals, and chiefly in their mode of increase by gemmation or budding, which may be either superior or inferior.

In illustration let us take the polyp with which we are most familiar, the common sea anemone, which though it secretes no corallum is yet very similar to many of the true coral polyps. The upper extremity of the anemone with its wreath of tentacles is called the disk, in the centre of which is the mouth. If in the coral polyp a fresh mouth appear in the disk, indicating the commencing growth of another polyp, the budding is said to be superior or terminal.

If a transverse section be made of a sea anemone the interior is found to be divided by membranes radiating like the spokes of a wheel; alternating with these in the coral animal are calcareous lamellæ, (Fig. 1,) but these frequently extend on all sides beyond the visceral cavity: should the growth of a fresh polyp proceed from these external portions of the lamellæ the budding is considered, as before, to be superior.

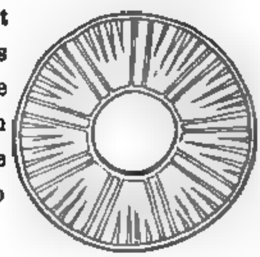


FIG. 1.

But when the base of the new polyp is connected with the base or lower portion of the parent polyp, the budding is said to be inferior. The growth of a polyp may be acrogenous in the direction of its length at the apex, (never at the base,) or it may be lateral in the direction of its breadth. These distinctions together with those relating to its mode of reproduction by superior and inferior budding will be found sufficient to account for the wondrously diversified forms presented by the stony corals.

Of the three principal groups into which coral zoophytes are divided the first is—

ASTREACEA.

In the genus Fungia, or mushroom coral, we have a thick circular or oblong disk, more or less convex above: the lamellæ radiate from a central depression answering to the mouth of the animal, and at the circumference are not bounded by any transverse partition or cell wall. The whole corallum is the framework of a single polyp, by the jelly flesh of which it is entirely covered. As the lamellæ diverge the interstices are longitudinally divided by shorter lamellæ, and from the point where each of these reaches the common height, a tentacle springs, so that in the place of the wreath surrounding the disk of an actinia, the whole disk of the Fungia polyp is covered with scattered tentacles. In the Fungia there is no increase by budding; ovules are given off which are at first free and endued with the power of locomotion, these soon become attached, often to the concave or under side of the parent; as growth proceeds they again become free, and are in a living state generally found resting amongst the branches of other corals. The colour of the animal is umber, with green tentacles: it is probable they have a limited power of motion.

In Fungia the animal is perfectly simple, but in Herpetolithus or the slug coral, the disk includes many polyp mouths, and in Polyphyllia or the mole coral, it is made up of a vast number of centers with short radiating lamellæ: yet the character of the Fungidæ is preserved by the absence of any partition between the centers; the lamellæ of one center uniting with those of the surrounding centers. The single visceral cavity being a distinctive mark of a polyp, we cannot consider the mole coral as a single highly compound animal, yet the junction of the polyps is so intimate that it is impossible to trace where one polyp begins or another ends.

Hitherto there has been a remarkable resemblance in form between the species examined: but the same absence of cells, the same intimate connexion between the polyps is observable in many Fungidæ having an entirely different aspect.

In Pavonia we have ascending thin clustered leaves gracefully spreading, or intersecting and coalescing so as to form a mass with angular or contorted intervals. The upper surface of the folia is covered with long and beautifully fine lamellæ radiating from star-like oviremes or polyp mouths: in some species both surfaces appear thus furnished, and the coral is termed bifacial, but this probably arises from the folding back of the leaf upon itself.

In Agaricia the form is a dimidiate plate, or sometimes resembles a delicate tazza vase on a short pedicel. This genus has been by Ohen much more aptly named Undaria, from the rippled or wave-like ridges covering the surface. The thin plate-like form of these Fungidæ is produced by the lateral growth of the polyps. If a simple polyp has acrogenous growth, increasing in the direction of its length, without budding, it forms a stem or column, the lower part closing as additions are made at the apex: if a number of such polyps grow side by side, a thick mass is produced: but when a polyp spreads itself horizontally only, its corallum is wafer-like, and if budding takes place near the circumference, the same thin flat form is extended, and is usually found encrusting other substances. But it frequently happens that polyps with this kind of lateral growth extend themselves not horizontally, but vertically, or in an ascending direction, thus forming a leaf-like corallum in which the axes of the polyps are in a horizontal position and the coral grows upward by their lateral increase.

In the classification of corals, the mere shape of the corallum is considered to be of little importance: thus in the Fungidæ we have thick circular or oblong disks, erect leaves,

or thin plates encrusting other corals, the distinguishing mark being the uninterrupted continuance of the lamellæ from one polyp mouth to another. Sand-like or granular projections called by Milne Edwards synapticules, very frequently beset both sides of the lamellæ in the genus Fungia.

In passing to the very extensive family Astræidæ, the first thing which may strike us is the circumscribed character of the cells; they may be large or small, circular, oblong, or greatly lengthened and sinuous, still they are enclosed by cell walls: no less obvious it is that these cell walls do not confine the lamellæ, which project through them, and into the spaces beyond them.

Most of the Astræidae exhibit a tendency towards a convex or hemispherical form, no other being so well adapted to remain uninjured in the dashing of the surges which perpetually beat upon the borders of the coral reefs. Let us now suppose a cluster of polyps forming a small hemisphere, and let it be required to contrive for them a mode of growth, which, without any change in the size of the polyps, shall preserve the form of the zoophyte unaltered, whilst the hemisphere of a few inches in diameter increases to one of many feet. Nature in the Astræidæ has practically solved this problem, not in one or two ways only, but in a vast variety, all equally admirable, for beauty of appearance and mechanical perfection. In some species the whole zoophyte is massive, the dome-like surface being nearly even; but in others the polyps that have grown originally from one parent do not coalesce with other surrounding families of polyps, and hence deep intervals are left between the calicles.

If a number of polyps occupy the surface of a hemisphere, each one having simple acrogenous growth, it is plain that in course of time their calicles will diverge and at their extremities become separated by wide intervals; in this way losing both space and strength ; in the Astræidæ this is

obviated by disk budding. The simplest case of disk budding is when the circular disk of a polyp with its fringe of tentacles lengthens into an oblong form ; the polyp mouth also in the centre of the disk becomes elongated and at length divides into two distinct mouths separated by an interval ; across this interval a double fringe of tentacles is at length formed, and thus in place of one, two distinct and perfect cells arise (fig. 2).

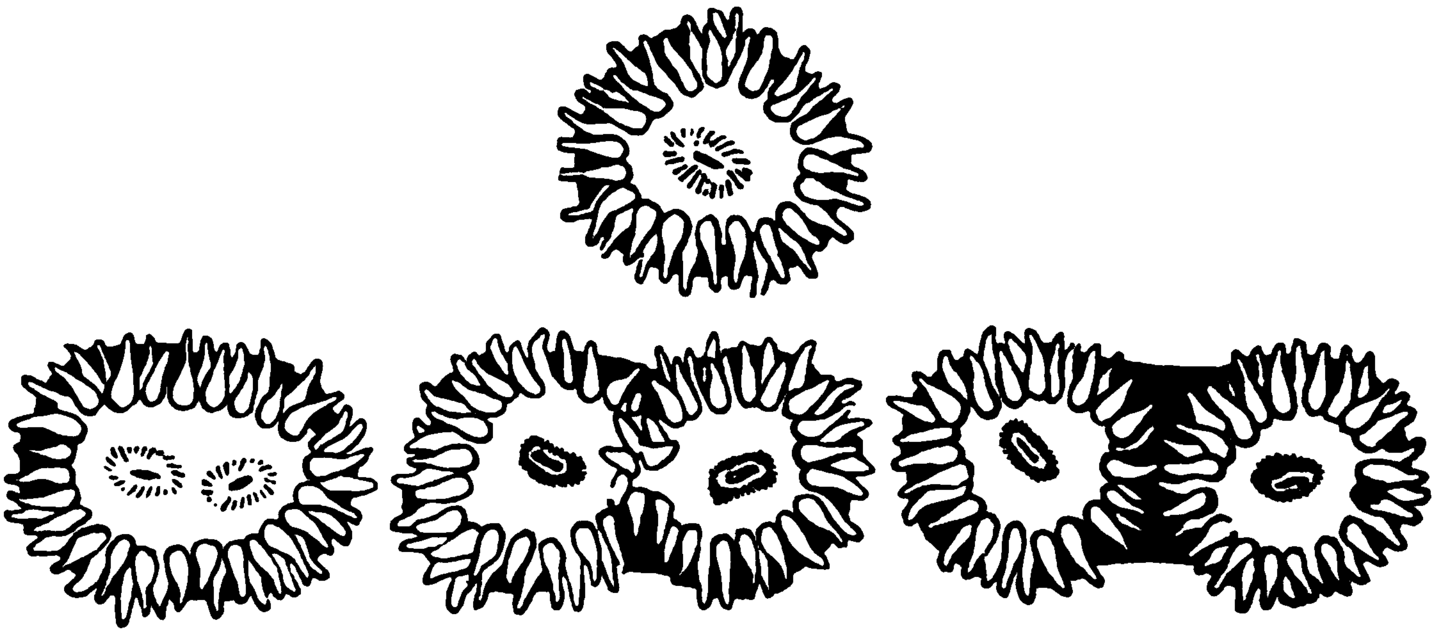


FIG. 2.

If with no further budding these two cells grow upward, a forked calicle is produced with cylindrical branches.

But if the parent cell instead of forming two distinct and similar cells widens continually as it ascends, we shall have a calicle in the form of a compressed funnel. The number of lamellæ occupying an inch of cell wall seldom varies in the same species, nor does the number of lamellæ surrounding a single polyp mouth. As compared with the parent cell, the compressed funnel-shaped calicle must therefore include a vastly increased number of lamellæ, and a proportionable number of polyp mouths.

Those two forms then, the forked calicle with cylindrical or turbinate branches (fig. 3), and the compressed funnel form, may be considered the types of growth in the segregate Astræidæ, that is in those species in which the calicles from separate parent cells do not altogether coalesce.

It is, however, very seldom these forms are found quite

symmetrical, the forked branches are contorted, and further dichotomous division takes place. The compressed funnel becomes sinuous or the sides instead of being parallel form large loops and bays, occupying every portion of space in the superficial area of the increasing hemisphere, yet never encroaching upon or even approaching too near other calicles of the same group.

FIG. 3.

In many of the massive Astræidæ long narrow meandering cells together with their cell walls occupy nearly the whole surface of the hemisphere, as in the common brain coral. These winding cells however long and intricate, are only modifications of the compressed funnel type, and each one includes polyps sprung from a single parent.

In other species the cells are polygonal like those of a honeycomb, but less regular in shape and size: as the mass increases and the cells come to have too many lamellæ for a single polyp mouth, the mouth lengthens, divides into two orifices, cell wall forms between them, and eventually two perfect cells take the place of the former one.

In a few species of massive Astræa the cells which are circular never change their form; and the contrivance by which the increasing intervals between the cells are filled up is very beautiful. It has been remarked that in all the Astræidæ the lamellæ are not circumscribed by the cell walls but radiate beyond them in every direction. Let us take three cells, occupying the points of an equilateral triangle; the

lamellæ radiating from these cells meet in the centre of the triangle. In the species we are now considering it is in such a central point, where lamellæ radiating externally from three or more cells meet, that a new polyp mouth opens which is soon surrounded by its own wall and a perfect cell is formed. (Fig. 4.)

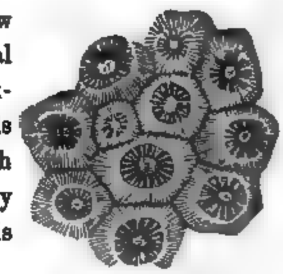


FIG. 4. ASTRÆA.

In Merulina and Echinopora, (fig. 5.) many of the species

FIG. 5. ECHINOPORA.

form thin plates encrusting other bodies or freely ascending. Nevertheless the growth as in the foliaceous Fungidæ is not a true upward growth but simply a widening of the plate in an ascending direction.

In Meandrina mammosa the ordinary convex form is much flattened and the coral is known to seamen as Neptune's shield. The hemispherical Astræidæ are connected through many gradations with erect, cylindrical, lobed, glomerate, and even ramose forms, but in all cases the increase is by gemmation proceeding from the lamellæ, within or without the cell, that is by that mode of gemmation which is termed superior.

In the genus Mussa, distinguished by the coarsely-toothed lamellæ, the polyps are from one to three inches in diameter, and are said to be the most gorgeously coloured of all the coral animals. In this genus as in Astræa and Meandrina the hemispheres grow to ten or twelve feet in diameter, adorning the ocean bed with starry cupolas, compared with which the far famed enamelled domes of the east are dull and colourless.

Amongst the most beautiful coralla of the Astræidæ are the species of the genus Tridacophylla, or lettuce coral, with large cells having walls as thin as paper; and the species of the genus Merulina, some of which have cells resembling in delicacy and beauty the hoar frost.

CARYOPHYLLACEÆ.

The second large group of stony corals, the Caryophyllacea, present some remarkable peculiarities: yet many intermediate genera, principally of fossil species, connect them with the Astræacea. The polyps of the Caryophyllacea have numerous tentacles disposed in two or more series: in most cases they are smaller than the polyps of the Astræacea, and they never widen at the disk. The parent polyp buds or gives forth young from its lower or immersed extremity, hence the gemmation is said to be inferior.

Corresponding distinctions may be observed in the coralla, the prevailing form of which is ramose or arborescent, and as the polyps never extend their lamellæ beyond the disk, the spaces between the cells are smooth or but slightly striated.

Cyathina is a genus of corals chiefly of small size and found in European seas. Cyathina Smithii inhabiting, though somewhat sparingly, the coasts of our own island. The calicles are goblet-shaped and solitary.

The Caryophylleæ form cylindrical ascending stems with shorter branches growing in various directions like the spray of an oak. The polyps have simple acrogenous growth, hence the tips of the branches only are in a living state. Each polyp as it grows lengthens its own branch, and is connected with the other polyps only by the lifeless stem of the zoophyte. (Fig. 6.)

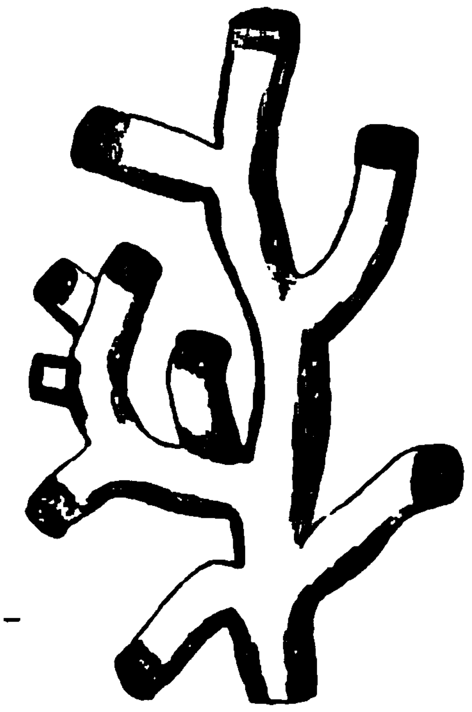


FIG. 6. CARYOPHYLLEA.

Dendrophyllia ramea, (fig. 7,) is remarkable for its tall stout sparingly-branched stems which are of a fine brown colour, and sometimes exceed five feet in height. It is an inhabitant of the Mediterranean. The solid thinly branching coral frequently by dealers called white coral, belongs to the genus Oculina, (fig. 8.) Its mode of growth is interesting, as illustrating in a striking manner the inferior gemmation of the Caryophyllaceæ. In the formation of a branch each polyp is at first at the apex; having attained its full growth it becomes inclined, and from the bend springs a new polyp, which having added its quota to the length of the branch, like its parent, turns aside and yields the leader's place to its offspring. This mode of growth often produces a slightly zigzag form in the branches of Oculina.

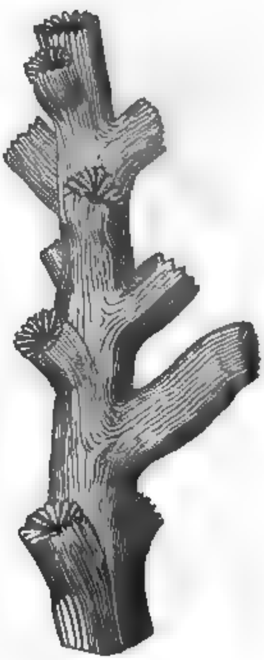


FIG. 7. DENDROPHYLLIA.

Although in the Caryophyllaceæ the lamellæ are never extended beyond the cell, the polyps have the power of secreting coral beyond the walls of their calicles. Thus in Anthophyllum, (fig. 9,) the cells or calicles stand immersed to a considerable depth in a spongy calcareous mass. The rude nodular or lobed masses of Anthophyllum have none of that elegance of form which distinguishes many of the Caryophyllaceæ, yet in a living state, with the polyps fully expanded, it is said to be one of the most beautiful of all the corals.

FIG. 8. OCULINA.

[redacted]

Inferior gemmation might seem ill adapted to produce explanate or foliaceous forms, yet in Gemmipora, (fig. 10,) some of the species expand in graceful fronds somewhat resembling those of the bird's nest fern. A transverse section clearly shews the polyps to be connected by their bases.

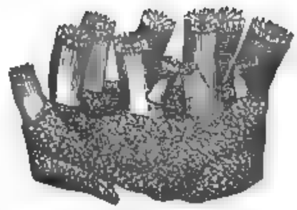


FIG. 9. ANTHOPHYLLUM.

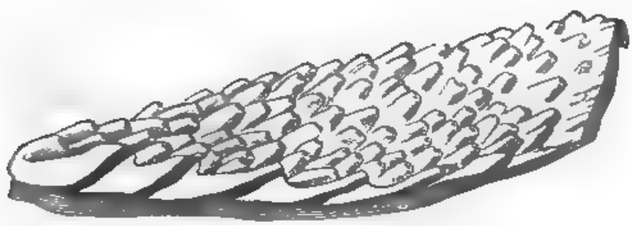


FIG. 10. GEMMIPORA.

The Caryophyllaceæ though frequently found on reefs, are not reef builders: many of them are amongst the most hardy corals. Astræas and Madrepores are limited to a latitude of 28° on either side of the equator and rarely live at a depth greater than twenty fathoms, but amongst the Caryophyllaceæ the Caryophyllidæ are found ranging from the equator to the frigid zone, and occur at all depths not exceeding two hundred fathoms.

MADREPORACEÆ.

The remaining large tribe of stony corals the Madreporaceæ, have in common with the preceding tribe inferior gemmation, but the polyps are always small and have very generally twelve tentacles, always disposed in a single row.

To the genus Madrepora belong the chief portion of the corals exposed for sale in this country. Their forms are exceedingly various, some resembling stag's horns, others grow

in even-topped cæspitose clusters, or from a central pedicel expand into a disk, concave and thickly studded with branchlets above. In almost all instances, however, Madrepores may be distinguished by their small prominent crowded calicles and arborescent growth. If we examine a branch of Madrepore coral we shall commonly find at the apex a single calicle more prominent, and somewhat larger than the rest. In this calicle resided the polyp from which all the others on the same branchlet successively proceeded by inferior budding.

Unlike the Oculinæ in which the youngest member of the polyp community is always leader, in the Madrepores the parent polyp never resigns its prominent position but is borne onwards and upwards by its continually increasing progeny.

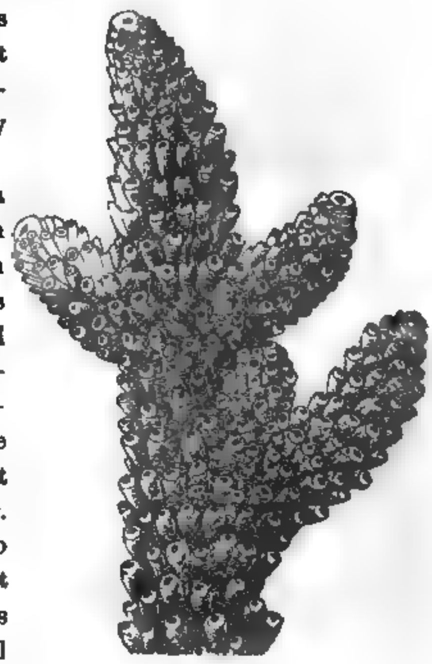


FIG. 11, MADREPORA.

We should thus have a simple cylindrical stem without branches, a form which is by no means frequent: how then shall we account for the beautiful and regular arborescent growths which are so characteristic amongst the Madrepores? (Fig. 11.) I have not space to enter upon the argument by which Dana supports his truly philosophical and, as I believe, mainly original view of the causes which regulate the mode of coral growth, but the theory itself may briefly thus be stated.

The act of reproduction in the polyp is conceived to require

a concentration of vital force at the budding point. In the vegetable kingdom it is familiar to every naturalist that as the seed is produced and ripens, the vital energy of the whole plant tends to the points where this process is going on, often indeed to such an extent as to deprive the rest of the plant altogether of life. Now in the Madrepore it is a single polyp which keeps throwing off buds in succession, the increase of the branch depending entirely upon the prolific power of the apical polyp. To meet the excessive demand thus made at a single point Dana conceives that the collective vital force of all the inferior polyps on the same branch is directed to the apical polyp which is thus enabled to continue its parental functions.

It is reasonable to suppose that only a certain definite amount of vital force is required for this purpose: when therefore the branch extends beyond a certain length, and more polyps are upon it than are required to keep the apical polyp in full reproductive activity; there will be a superfluity of vital force which may be available in another direction.

Accordingly at a certain distance below the apical polyp, varying in the different species, this superfluous force accumulates in one of the lateral polyps, which forthwith begins to extend itself and to bud, and in this way branches are successively formed at equal intervals, the length of the interval being determined by the number of polyps required for a sufficient accumulation of vital force at the extremity of the branch. External influences such as light and the direction of currents often greatly modify the form of the Madrepore: some species have lengthened stems before they begin to branch; others are secund or have living polyps on one side only of the branch; but for the most part the interval between the branches, and the angle which they make with the stem is in the same species extremely constant, giving rise to the various regularly arborescent forms which distinguish the Madrepores as the most beautiful of all the stony corals.

In Pocillopora it is not a single apical polyp, but an apical cluster of polyps which grows and buds—(See the numbered illustration in fig. 8.) The cells are not prominent as in the Madrepores, but resemble little cups, whence the name. The surface of the more robust species is covered with small warty tubercles, each containing a small group of polyps, and indicating the tendency of the Pocilloporæ to increase by budding clusters.

In the Millepores the polyps are extremely minute, and have not hitherto been sufficiently observed. The corals are often large, and their forms, resembling more or less the horn of an elk, are quite peculiar to the genus.

In Porites, (fig. 12,) the cells though larger than in the Millepores, are shallow or altogether superficial, indicating that the upper portion of the polyp does not secrete coral. The whole mass of the corallum is therefore covered to a considerable depth with the fleshy bodies of the polyps. The corals occur in rude masses or hillocks, sometimes of twenty feet in diameter, and in the ramose species the branches are bluntly rounded or club shaped. The corallum is altogether porous within.

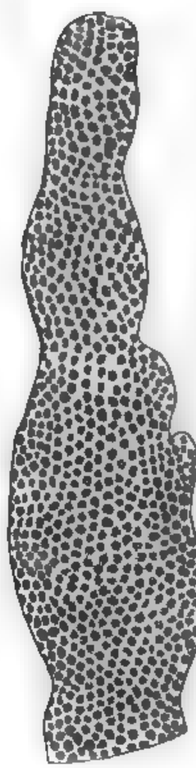


FIG. 12, PORITES.

Such are the principal genera of the Madreporaceæ. Never extending beyond the tropical seas they are so constructed as to flourish in conditions as unlike as possible. In the still waters of lagoons, formed by the sheltering reef of the atolls, grow the branching Madrepores, some of them so delicate that it is difficult to touch without injuring them ; from these extend

intermediate forms adapted to intermediate conditions, till we come to the rude and almost indestructible masses of Porites able to endure, and in fact only able to exist in, the surges of an ocean which is never at rest.

We have now completed our very imperfect notice of some of the various modes of growth in the three great tribes of stony corals, and we are led to observe, from what few and simple elements has all this diversity been elaborated? The second and third of these tribes are distinguished from the first by the position in which the young polyp springs from its parent. In the first tribe, the Astreaceæ, the buds open in the disk or from the rays extending beyond the disk. It might almost be predicted from geometrical reasons alone, that from this mode of budding hemispherical forms would predominate; and such is the case: expansions, stratiform, or erect and foliaceous, occur but as it were only in sufficient numbers to show that in nature adherence to a plan is not from blind necessity, but arises from intelligent design.

In the Caryophyllaceæ the buds spring from the lower portion of the polyp, originating in most instances strongly branched forms, always preserving the calicles distinct one from another, and, with few exceptions, allowing each polyp in its turn to be at the apex of the branch.

In the Madreporaceæ, the apical polyp or cluster of polyps advances continually as it buds, forming in some of the species the most delicate, in others the most enduring of all the stony corals.

Coral reefs are at present formed only in tropical seas, but within these their extent is very great. In Mr. Darwin's map eight principal barrier reefs are marked, that of N.E. Australia extending for a thousand, and that of New Caledonia for four hundred miles. More than seventy atoll formations are shewn, some of them in groups nearly five hundred miles in length: and to these must be added more than twenty distinct groups

of fringing reefs, the combined length of which probably exceeds six thousand miles. All the buildings of every kind that from the very first have been erected by mankind upon the earth, would appear insignificant if compared in substance with the structures of the polyps.

But if we would appreciate the part which has been taken by polyps in the distribution of the solid materials of the world, we must include in our account the vast extent of coral formations belonging to periods before the appearance of man.

M. Agassiz attributes a duration of 400,000 years to some species of coral zoophytes now found in the West Indies; a statement which, if trustworthy, is of peculiar interest to the geologist as indicating how vast a lapse of time has occurred since the period of even the most recent of the tertiary deposits.

According to Professor Owen, corals were more widely diffused and individually abundant in the Silurian age than at any subsequent period. "The Silurian limestone of Wenlock Edge, is in itself a coral reef thirty miles in length, and the Plymouth limestone and carboniferous limestone have frequently the aspect of coral banks skirting the older regions of Cambrian slate and Devonian killas. The structure of coral banks may be studied in the lofty limestone cliffs of Cheddar, and in the wave-worn shores of Loch Erne, as well as in the upheaved coral islands of the southern seas." Besides these, many large beds of coral are found in more recent formations, especially in the oolite. If such then be the extent to which the coral animals have contributed in forming the solid materials of this island, how vast must be the mass of coral throughout the world, yet every portion of it has been elaborated particle after particle by polyps, and has been held in solution by the fluids in the bodies of these tiny operators.

It has no doubt often been observed that in nature great results are very generally effected by the multiplication of

small causes. All the water that fertilises the surface of the earth has for this purpose been made first to assume the form of drops; these drops being themselves collections of watery particles so small as to be capable of being held in suspension by the atmosphere. A single grain of wheat is small, but yet along with others it yields the chief ingredient in the staff of life. The action and reaction between two contiguous grains of sand must be a small force, yet it is a constituent of a power sufficient to resist the sea in its might. The friction at any point between two fibres of a strand must be small, yet, in the absence of adhesive matter, this friction multiplied is the strength of all ropes longer than the fibres which compose them. Indefinitely smaller than any of the forces we have yet alluded to may probably be those molecular forces which in combination give the diamond its hardness and to steam and gunpowder their wondrous propelling power. Multiplication of the same small unit of force past all bounds of calculation seems to lie at the foundation of the laws of matter and material changes. And in the world of organic beings it almost seems as if the more minute the creature the more wondrous its productions. Inconspicuous protozoa build monuments which diminished by the mightiest monuments of man, the pyramids, seem scarcely to have suffered any loss.

It may be possible to find a parallel to this in the immaterial world. A truth of overwhelming significance forbids us to set a limited value on even a single soul of man; yet in the presence of that one living MIND which thought out the universe, man seems only able to love honour and obey in an infinitesimal degree: nevertheless it may be that the temple of His glory is ordained to rise, like the atol of the southern ocean, by increments countless and imperceptible, unless to Him of whom it is written, that rejoicing in the good of all His creatures, He inhabiteth the praises of eternity.

FIFTEENTH ORDINARY MEETING.

Royal Institution, 30th April, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The resignation of Mr. Eden was received and accepted.

Mr. John William Otto Fabert was balloted for and elected an Ordinary Member.

This meeting being the last of the session was devoted to miscellaneous communications.

Mr. T. C. Archer described an appearance bearing strong resemblance to a comet, which he witnessed on the morning of the 29th April, in the zone between the Great Bear and the horizon.

Mr. Morton exhibited a number of interesting organic remains (*Lingula, Theca, Asaphus, Trimucleus, Euomphalus,* and *Dictyonema*) from the Lower Silurian (Cambrian) district of Shelve, in Shropshire—the typical Siluria of Sir Roderick I. Murchison.* On a small scale it exhibits the grander features of Snowdonia, and affords greater facilities for examination. To the east is the Longmynd, accounted the oldest land in England, consisting of about 35,000 feet of slate rocks, intersected by numerous trap dykes. These "bottom rocks," long considered non-fossiliferous, have lately yielded organic remains to the assiduous researches of Mr. Salter. Above them are the Lingula flags, chiefly remarkable for the cropping out of strata of associated quartz rocks, called the Stiper stones, which exhibit a succession of rocky ridges very conspicuous over the surrounding scenery.

* See section, "Siluria," p. 29.

They present no certain fossil evidence, though some small cavities in the quartz rock are considered by Mr. Salter to have been occupied by lingula previous to the metamorphism of the strata. Above these hard siliceous rocks, a series of strata repose, representing the Llandeilo formation, from which the fossils exhibited were collected. The first three genera were found within a few hundred yards of the Stiper stones; the rest were higher in the series. A very interesting collection was obtained from the upper Llandovery rocks,—strata which lie unconformably with any of the formations below.

Dr. COLLINGWOOD, on behalf of Mr. HENRY DUCKWORTH, exhibited some fossils from the London clay.

Mr. STATTER exhibited and described his decimal clock, and explained at length the principles of his system applied to time, measurement, capacity, weight, and money.

Dr. EDWARDS continued his experimental illustrations of magnetic light.

The business being closed the Society adjourned.

The SOCIETY at its various meetings had the following donations laid upon the table, and recorded its grateful thanks to the donors.

DONATIONS

FROM MAY 1859 TO MAY 1860.

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tober 3rd, 1859. *From the Author* — The Fauna of Blackheath and its vicinity; The Estuary of the Mersey considered as a locality for Nudibranchiate Mollusca; and On the Morphology of Plants; all by C. Collingwood, M.B., F.L.S.

tober 17th, 1859. *From the Institution* — Reports of Smithsonian Institution, 1856-7, 2 Vols.

From Dr. Inman — British Association Reports: Leeds Meeting.

From the Society — Journal of Proceedings of the Linnæan Society, Vol. xiv, Nos. 13 and 14, and Supplement to Botany, No. 2.

From the Society — Proceedings of the Dublin University Zoological and Botanical Association, Vol. i. No. 2.

From the Lords Commissioners of the Admiralty — Report of the Teneriffe Astronomical Experiment of 1856, by Professor C. Piazzi Smyth.

From the Society — Journal of the Statistical Society of London, Vol. xxii. Part 3.

From the Society — Transactions of the Royal Scottish Society of Arts, Vol. v. Part 2.

From the Society — Proceedings of the Zoological Society of London, Nos. 370 to 383, and Part 1, 1859.

From the Society — Journal of the Royal Dublin Society, Nos. 12, 13, and 14, 1859.

From the Society — Transactions of the Plymouth Institution and Devon and Cornwall Natural History Society, 1857-8 and 1858-9.

From the Society — Proceedings of the Belfast Natural History and Philosophical Society, 1859.

From the Society — Notices of the Royal Astronomical Society, Vol. xix. Nos. 6, 7, 8 and 9.

From the Committee — Report of the Birkenhead Free Public Library, 1859.

From the Society — Proceedings of the Liverpool Philomathic Society, Vol. iv.

From the Society — Report of the Proceedings of the Geological and Polytechnic Society of Yorkshire, 1858-59.

From the Author—Improved Method of Graduating Hydrometers, by Professor Elliot.

November 14, 1859. *From the Society* — Notices of the Royal Astronomical Society, Vol. xix. No. 10.

From the Society — Twenty-sixth Annual Report of the Cornwall Polytechnic Society.

From the Institution — Notices of Proceedings of the Royal Institution of Great Britain, Part 9, July 1859.

From the Author—On the Influence of the Microscope upon the Progressive Advance of Medicine. By C. Collingwood, M.B.

From the Society — Proceedings of the Zoological Society, 1859, Part 2.

November 28th, 1859. *From the Society*—Journal of the Royal Dublin Society, No. 15, October 1859.

December 12th, 1859. *From the Society*—Transactions of the Botanical Society of Edinburgh, Vol. vi. Part 2.

From the Society—Jour. of the Linnæan Society, Vol. iv. 15.

January 9th, 1860. *From the Society* — Notices of the Royal Astronomical Soc. Vol. xx. Nos. 1 and 2; Instructions for Observations on Mars at Opposition in 1860.

From the Society — Journal of the Statistical Society, December, 1859.

From the Society — Journal of the Geological Society of Dublin, Vol. viii. No. 2.

From the Author — Character of the Liverpool Town Museum, with Suggestions for its Interior Arrangement. By the Rev. Dr. Hume.

January 23rd, 1860. *From Mr. Carey, Boston, U.S.* — Report of the Commissioners of Patents (Agriculture), 1854, Washington, U.S.

From the Society—Transactions of the Tyneside Naturalists' Field Club, Vol. iv. Part 2.

From the Society — Transactions of the Royal Scottish Society of Arts, Vol. v. Part 3.

From the Committee—Eleventh Annual Report of the Royal Museum and Library, Borough of Salford, 1859.

February 20th, 1860. *From the Author* — Foundation for a New Theory of Principles and Practice of Medicine. By Dr. Inman.

March 6th, 1860. *From the Society* — Journal of the Statistical Society, Vol. xxiii. Part 1.

From the Society — Journal of the Proceedings of the Linnæan Society, Vol. iv. No. 16.

March 19th, 1860. *From the Society* — Notices of the Royal Astronomical Society, Vol. xx. Nos. 3 and 4, and List of Fellows.

From the Society — Proceedings of the Chatham Society, Liverpool, 1858-59.

From the Society — Journal of the Proceedings of the Linnæan Society, Supplement to Vol. iv. (Botany).

April 2nd, 1860. *From James Yates, Esq., Corr. Memb.* — Report of the fourth General Meeting of the International Association for obtaining a uniformity of Measures, Weights, and Coins, after the Decimal System.

From the Author — The Decimal System as a whole. By R. Dover Statter.

April 16th, 1860. *From the Society* — Proceedings of the Zoological Society, 1859, Part 3.

April 30th, 1860. *From the Society* — Notices of the Royal Astronomical Society, Vol. xx. Nos. 5 and 6.

From the Society — Proceedings of the Royal Society of Edinburgh, 1858-59.

From the Club — Proceedings of the Berwickshire Naturalists' Club, Vol. iv. No. 3.

From the Institute — Journal of the Franklin Institute of Pennsylvania, Vol. xxxix. Nos. 1, 2, 3, and 4.

From the Society — Report, Proceedings of the Geological and Polytechnic Society, West Riding of Yorkshire, 1859.

From the Society — Transactions of the Royal Society of Literature, Vol. vi. Part 3, second series.

From the Society — Annual Report of the Yorkshire Philosophical Society, 1859.

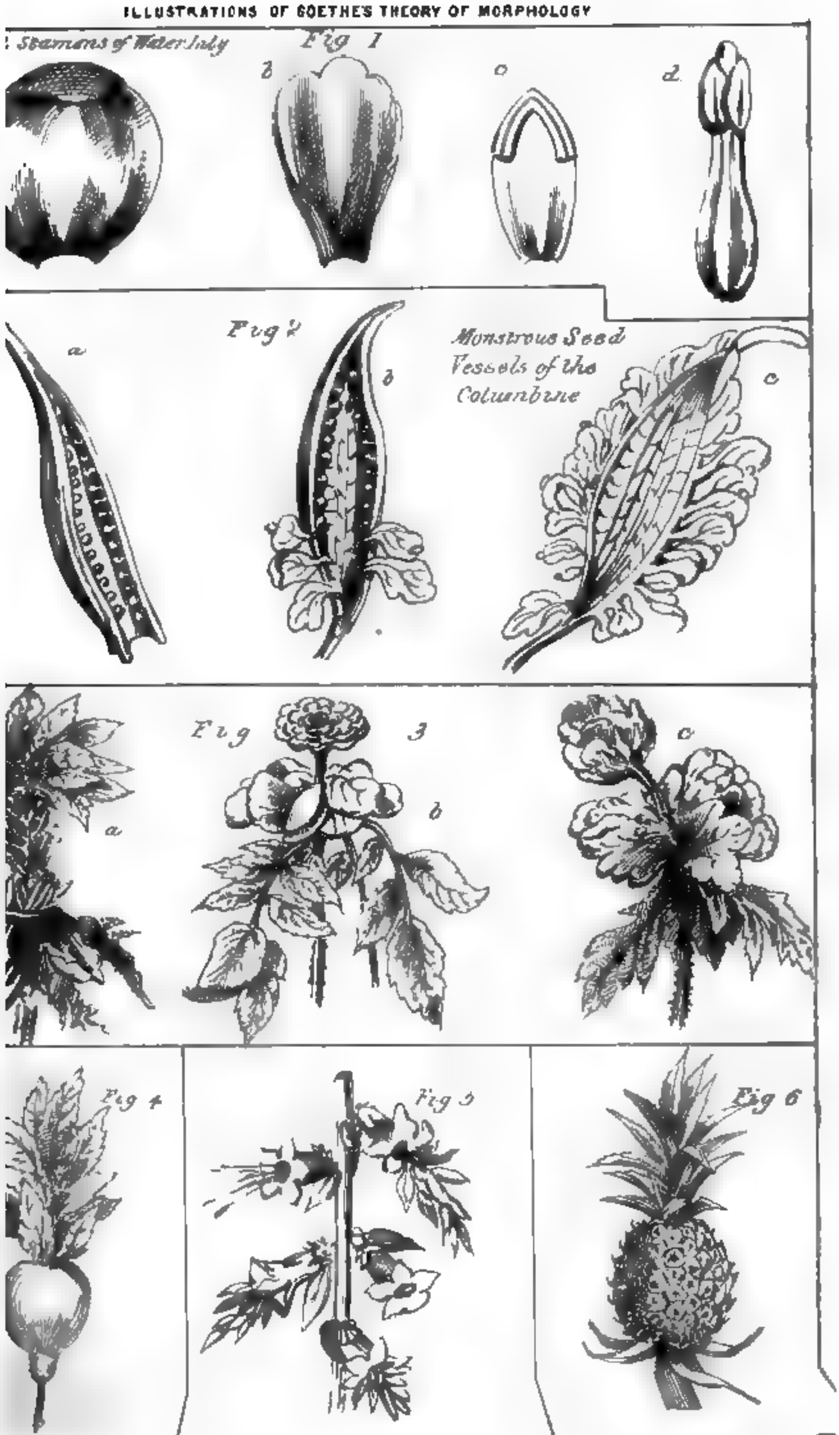
From the Society — Transactions of the Historic Society of Lancashire and Cheshire, Vol. xi, 1858-59.

NOTICE TO MEMBERS.

The next Session will open on Monday the 1st of October, and thereafter meetings will be held fortnightly (excepting at Christmas) till the end of April.

It is important that the Secretary should receive early intelligence of the intention of members to contribute papers, that suitable arrangements may be made; and it is very desirable that these communications should embrace the various subjects which come before the society, viz.:—Literature, Science, and Art. Party Politics and Controversial Divinity are excluded.

ILLUSTRATIONS OF GOETHE'S THEORY OF MORPHOLOGY



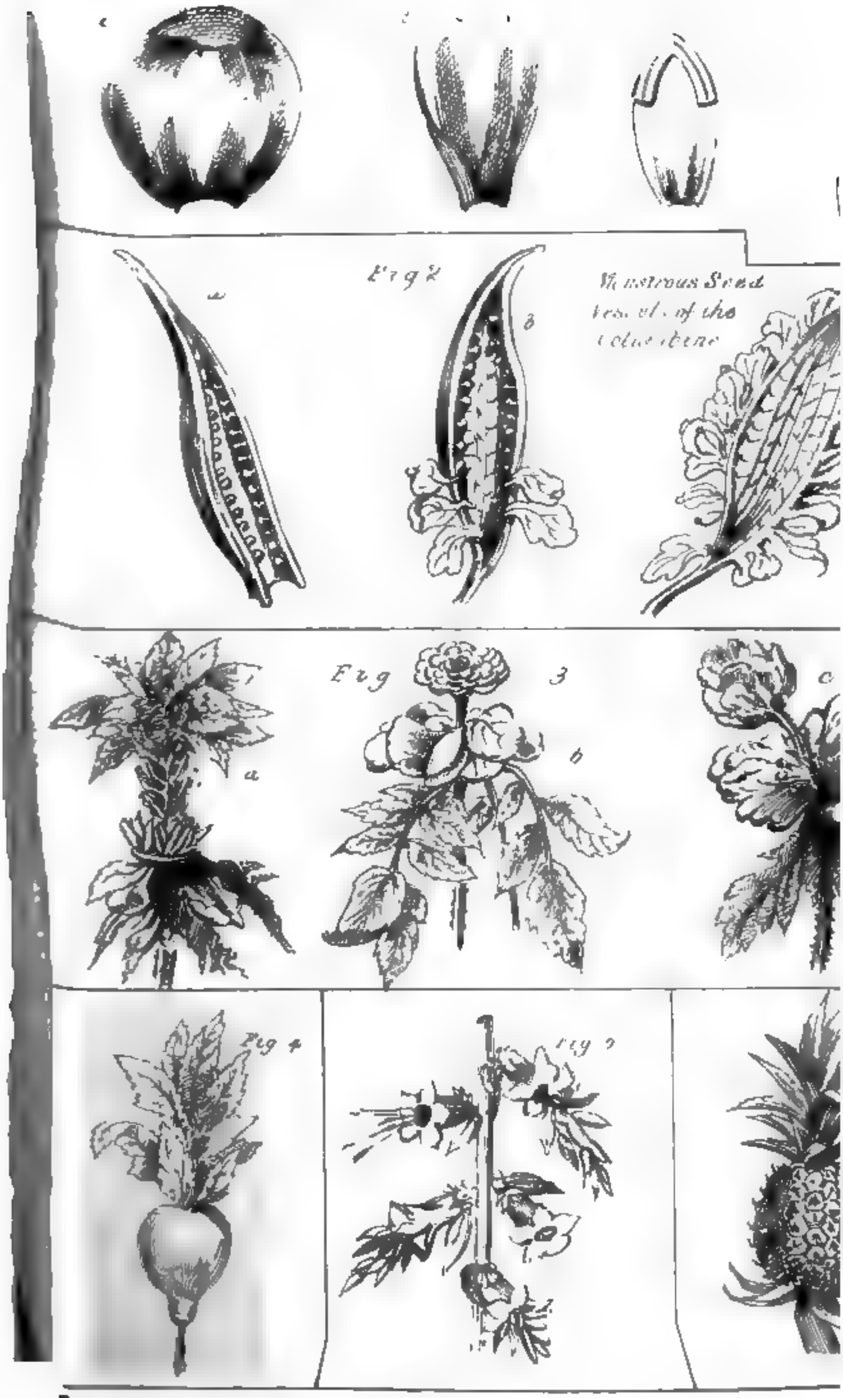
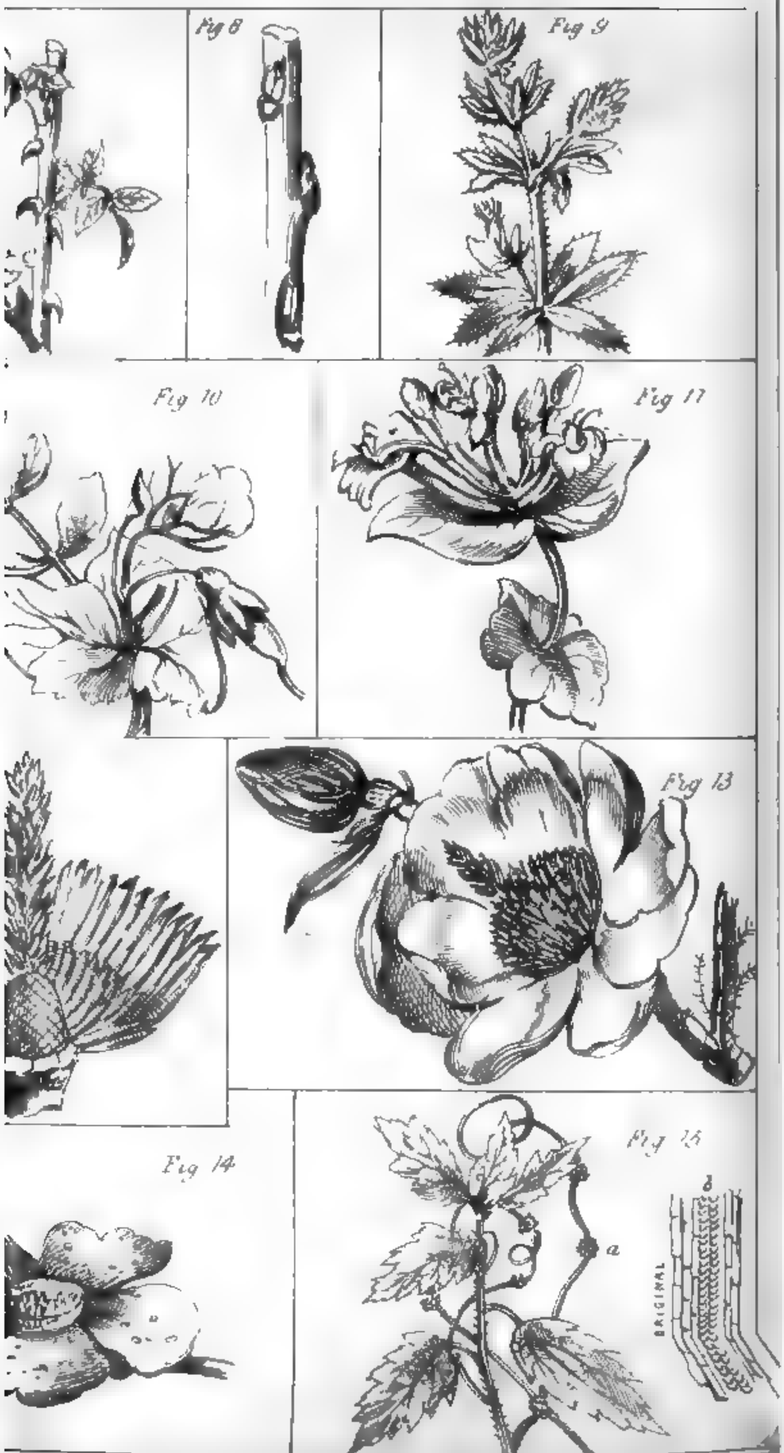


Fig 2
Monstrous Seed
Fig 3
Fig 4

ILLUSTRATIONS OF THE NATURAL LAW OF DEVELOPMENT IN LEAVES & FLOWERS



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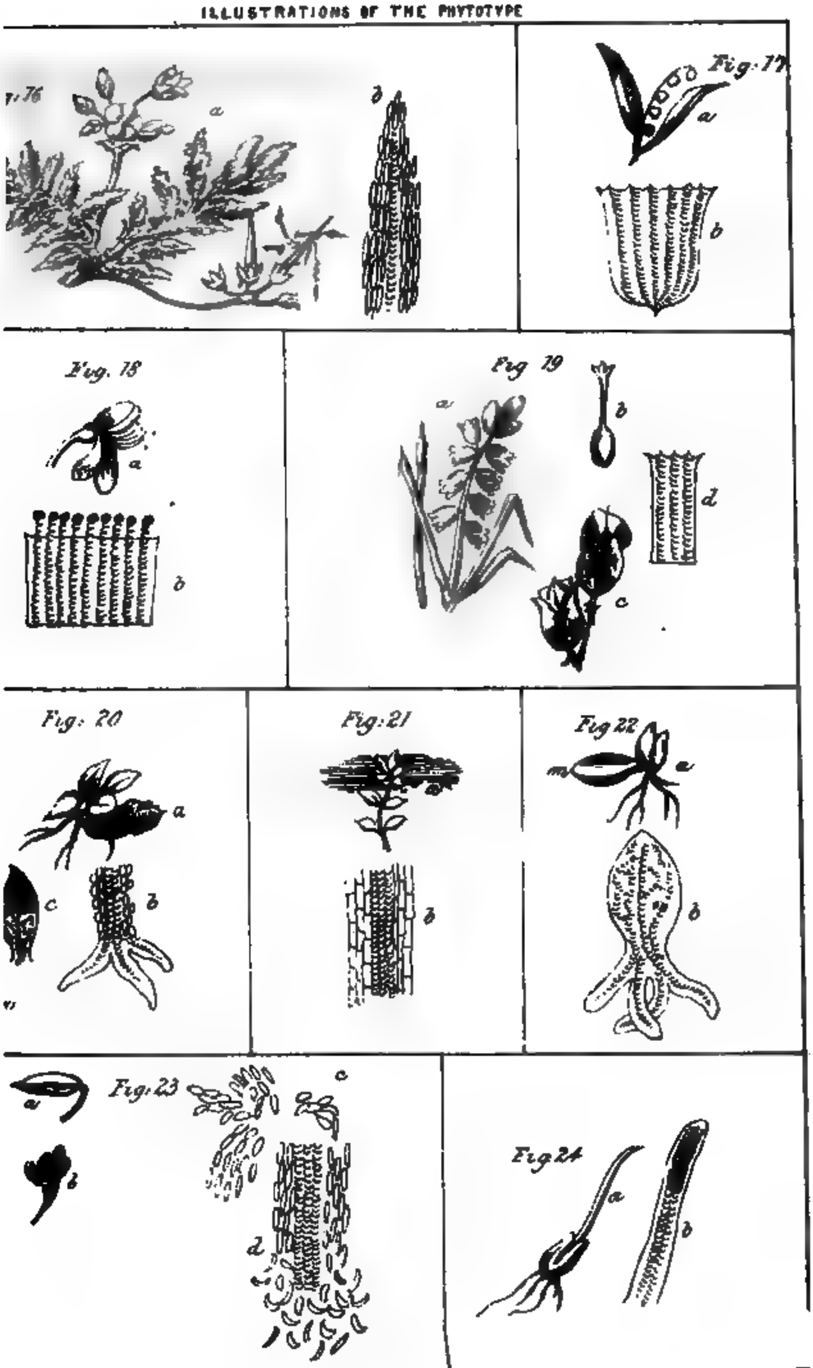

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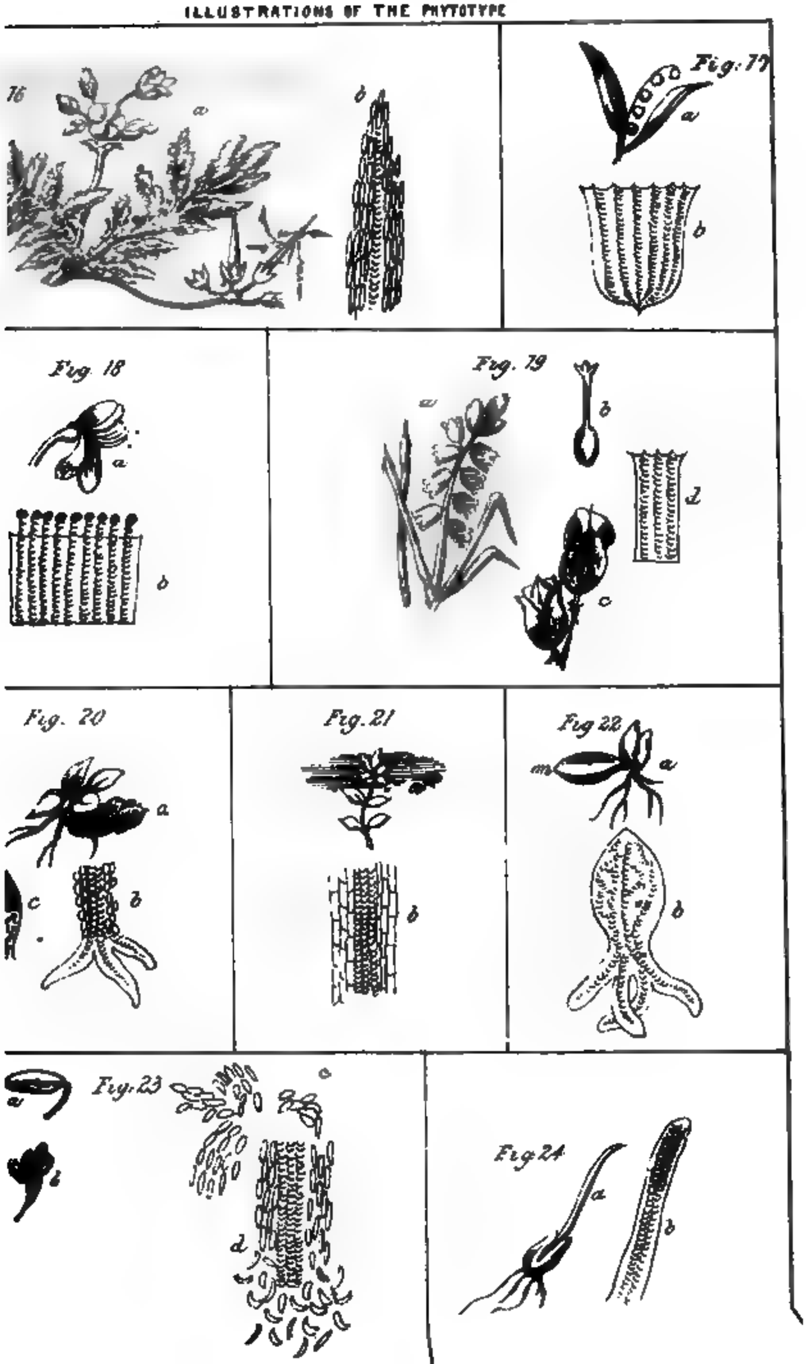
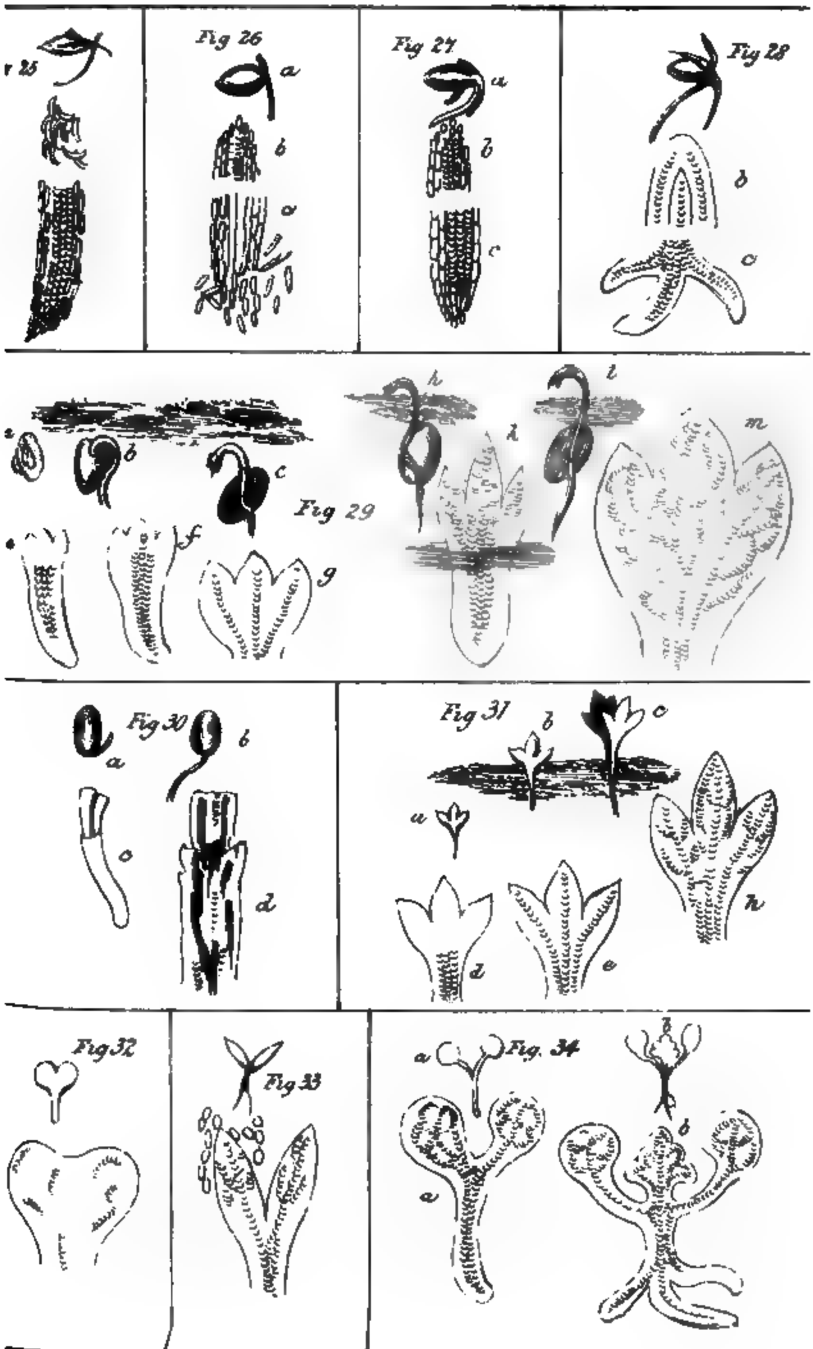
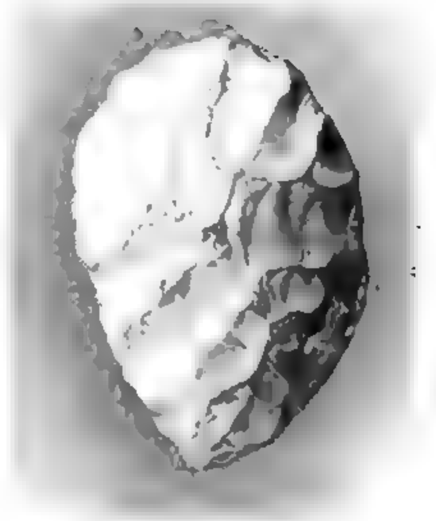


. IV ILLUSTRATIONS OF THE PHYTOTYPE CONTINUED



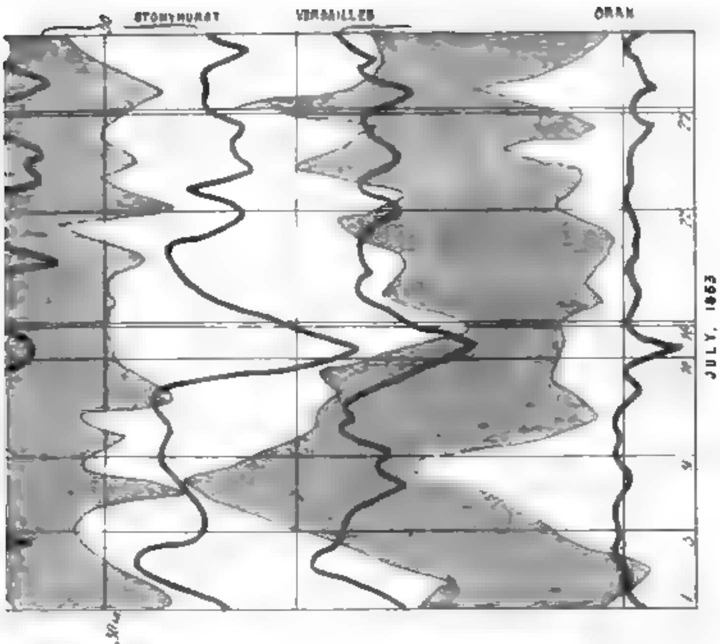


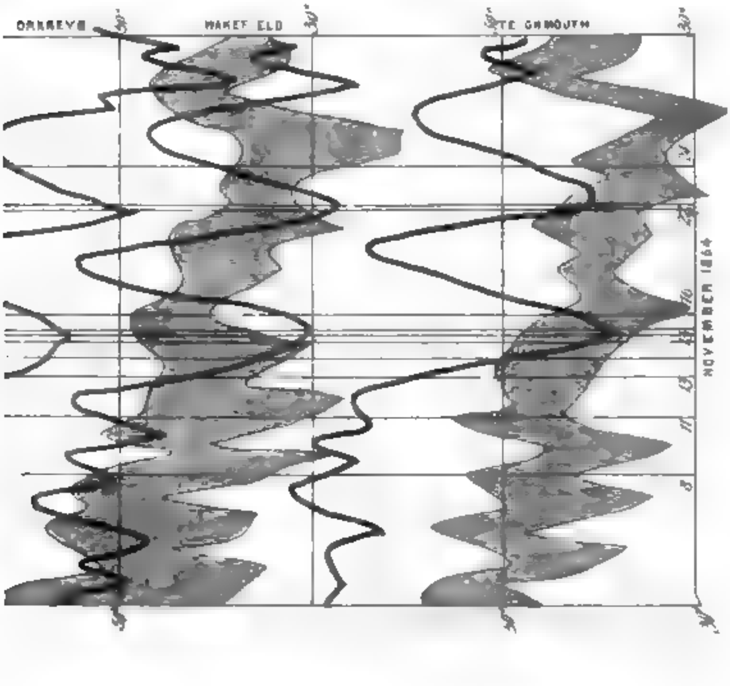
ABBEVILLE

AMIENS

½ Size

Predominant Forms of Flint Implements found in the Valley of the Somme


STONYHURST
VERSAILLES
ORAN
JULY, 1863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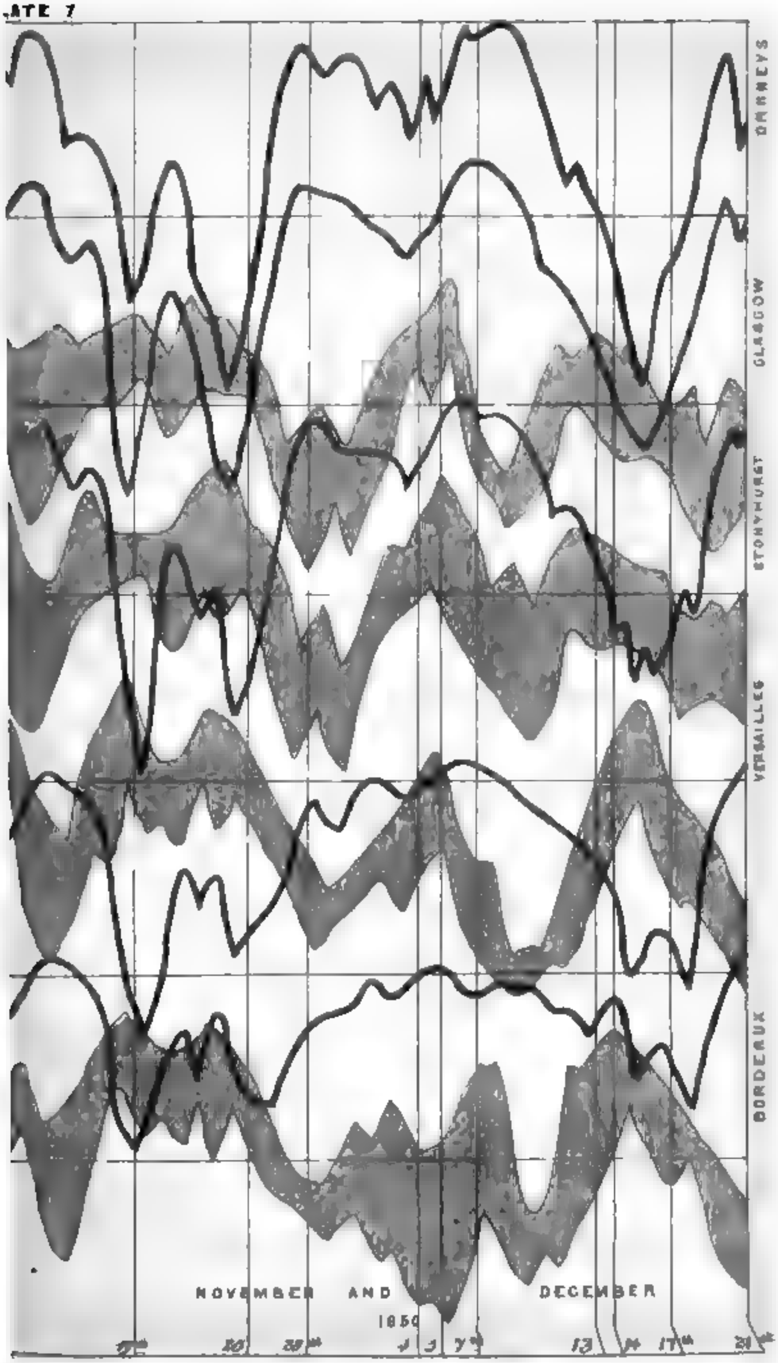

APPENDIX.

ON THE

HEPATICS AND LICHENS

OF

LIVERPOOL AND ITS VICINITY.

BY

FREDERICK P. MARRAT.

READ BEFORE THE SOCIETY ON THE 6TH OF MARCH, 1860.

LIVERWORTS occupy an intermediate position between Mosses and Lichens. The quadrivalve capsule common among these plants resembles that of the genus Andræa, which consists of Alpine mosses. The Jungermannia juniperina, having falcate leaves, is scarcely distinguishable by the unassisted eye from Andræa nivalis. The roundish antheridea connect them with the sphagna. Folding leaves, so often met with among the Hepatics, are faintly represented by the various species of Fissidens. The foliose liverworts are nerveless, if we do not consider the pellucid appearance in the centre of the leaf of Jungermannia albicans to be analogous to that organ. The elastic spiral elaters found in the capsules of Jungermannia, which serve the purpose of distributing the spores, form highly curious and very interesting microscopic objects. The Riccia resembles Lichens in its mode of growth, and in the situation of its fruit on the surface of the frond.

HEPATICÆ.

A. Leaf and stem joined together.

Order I.—ANTHOCEROTEÆ.

Genus I.—ANTHOCEROS.

A. punctatus. (Dotted A.) E. B., T. 1537,

By the side of a long lane leading from Wallasey to Leasowe.—*W. H.*

Order II.—MARCHANTIACEÆ.

Genus II.—MARCHANTIA.

M. polymorpha. Linn. (Many shaped M.) E. B., T. 219.

In ponds and very wet places frequent. Fruiting in July.—*F. P. M.* At Gillbrook.

Genus III.—FEGATELLA.

F. conica. Linn. (Conical F.) Linn. Spec. Plant. 1604.

Wet rocks, bridges, &c. Fruiting on the bridge of the railway betwixt Spital and Bromboro' stations in April.—*F. P. M.*

Genus IV.—REBOUILLIA.

R. hemispherica. Linn. (Hemispherical R.) E. B., T. 503.

On the sandhills from Crosby to Southport generally plentiful. Fruiting in May and June.—*F. P. M.*

Order III.—RICCIEÆ.

Genus V.—RICCIA.

R. chrystallina. Linn. (Chrystalline R.) Smith's E.B., T. 2546.

Botanic Gardens.—*W. H. and F. P. M.*

R. fluitans. Linn. (The Floating Riccia.) E. B., T. 252.

In a pit near Halewood.—*W. H.* In a pond near Knowsley.—*Rev. H. H. Higgins and F. P. M.*

ORDER IV.—PELLIEÆ.

Genus VI.—BLYTIA. (ENDLICH.)

B. LYELLII. Hook. (Lyells B.)

In a damp valley near Carr Mill Dam.—*F. P. M.*

B. HIBERNICA. Hook.

Sandhills from Crosby to Southport; with calices, in October.—*W. Wilson and F. P. M.*

Genus VII.—FOSSOMBRONIA. (RADDI.)

F. PUSILLA. Linn. (Tiny F.) Hook. T. 69.

On a wet clay ditch bank, near Little Storeton. Fruiting in October.—*F. P. M.* Wet rocks, Bromboro' Woods, Carr Mill Dam.—*Rev. H. H. Higgins and F. P. M.*

Genus VIII.—METZGERIA. (RADDI.)

M. FURCATA. Linn. (Forked M.) Hook. T. 55 and 56.

On trees and rocks, Bromboro' Woods. On trees, Sutton. Fruiting in April.—*F. P. M.*

VAR. M. ÆRUGINOSA.

Trees, Bromboro' Woods.—*F. P. M.*

Genus IX.—ANEURA. (DUMORTIER.)

A. PINGUIS. Linn. (Flat A.) Hook. T. 46.

Moist clay banks. River bank beyond New Ferry.—*H. F.* Fruiting in April.—*F. P. M.*

A. MULTIFIDA. Linn. (Many cut A.) Hook. T. 45.

Clay banks, common. Fruiting in April.—*F. P. M.*

A. PALMATA. Nees.

In ditches and very wet places.—*F. P. M.*

Genus X.—PELLIA.

P. EPIPHYLLA. Linn. (Overleaf P.) Hook. T. 47.

Wet rocks, side of ditches, &c., very common. Fruiting in April. *F. P. M.*

Genus XI.—BLASIA. (MICHELI.)

B. PUSILLA. Linn., Hook. T. 82, 83, 84.

Among gorse, Walton Mere.—*H. F.* Heathy rocks near Prenton.—*F. P. M.*

B. Leaf and stem distinct.

ORDER V.—JUNGERMANNIEÆ.

Genus XII—LEJEUNIA. (LIBERT.)

L. SERPYLLIFOLIA. Dicks. (Thyme leaved L.) Hook. T. 42.

Trunks of trees, Bromboro' Woods.

L. MINUTISSIMA. Hook. (Smallest L.) Hook. T. 52.

In the first lane past the quarry at Greenbank, growing with *Plagiochila undulata.*—*F. P. M.*

Genus XIII.—PHRAGMICOMA. (DUMORT.)

P. MACKAJI. Hook. (Mackay's P.) Hook. T. 53.

On a heath beyond Flaybrick Hill.—*F. P. M.*

Genus XIV.—FRULLANIA. (RADDI.)

F. DILATATA. Linn. (Dilated F.) Hook. T. 5.

On trees and rails, common. Fruiting in March and April.—*F. P. M.*

F. TAMARISCI. Linn. (Tamaresk F.) Hook. T. 6.

Bidston, on the road bank near the toll-bar. On an old wall at Higher Bebington.—*F. P. M.*

Genus XV.—PTILIDIUM. (NEES.)

P. CILIARIS. Linn. (Fringed P.) Hook. T. 65.

In several places on Bidston hill, but not abundantly.

Genus XVI.—RADULA.

R. COMPLANATA. Linn. (Flattened R.) Hook. T. 81.

On trees not uncommon. Fruiting on trees Bromboro' Woods in March.—*F. P. M.*

Genus XVII.—HERPETIUM. (NEES.)

H. REPTANS. Linn. (Creeping H.) Hook. T. 75.

Abundant on heathy ground. Fruiting in Eastham Wood in May.—*F. P. M.*

Genus XVIII.—CALYPOGEIA. (RADDI.)

C. TRICHOMANES. Dicks. (Trichomanes C.) Hook. T. 79.

Hedge banks, and rocky places, particularly near heaths, common, frequently with *gemmæ.*

Genus XIX.—SACCOGYNA.

S. viticulosa.

Among *Dicranum majus* in Bromboro' Wood behind Patrick Wood.—*F.P.M.*

Genus XX.—CHEILOSCYPHUS. (Corda.)

C. polyanthus. Linn. (Many-flowered C.) Hook. T. 62.

Ponds, ditches, and the sides of wells. Fruiting in April.—*F.P.M.*

Genus XXI.—LOPHOCOLEA. (Nees.)

L. bidentata. Linn. (Two-toothed S.) Hook. T. 30.

Very common. Fruiting in April.—*F. P. M.*

var. L. obtusata.

In a lane near the railway station at Bebington.—*F. P. M.*

L. heterophylla. Schrad. (Odd-leaved L.) Hook. T. 31.

On the stems of trees growing in damp places, not uncommon.—*F. P. M.*

Genus XXII.—SPHAGNOCÆTIS. (Nees.)

S. sphagni. Dicks. (Bog-moss S.) Hook. T. 33.

On the mosses among *sphagna*; Simon's Wood, Rainford, Bidston, &c.

Genus XXIII.—JUNGERMANNIA.

J. albicans. Linn. (Whitish J.) Hook. T. 25.

Walls, hedge banks, &c., common. Fruiting on Flaybrick hill in April.—*F. P. M.*

J. ventricosa. Dicks. (Bellied J.) Hook. T. 28.

Bidston Hill and the high levels of Cheshire. Fruiting on Flaybrick Hill in April and May.—*F. P. M.*

J. barbata. Schrad. (Bearded J.) Hook. T. 70.

Fruiting on Flaybrick Hill in April.—*F. P. M.*

var. J. minor. Hook.

Fruiting on Flaybrick Hill in April and May.—*F. P. M.*

J. bicuspidata. Linn. (Two-pointed J.) Hook. T. 11.

Damp walls and heathy places. Fruiting on a wall at Bidston, November.—*F. P. M.*

J. setacea. Web. (Bristle-like J.) Hook. T. 8.

On all the mosses abundant, and at Bidston and Heswell Hills.—*F. P. M.*

J. inflata. Hud. (Inflated J.) Hook. T. 38.

In similar situations with the last. Fruiting in October.—*F. P. M.*

J. Funckii. Web. and Mohr. (Funck's J.)

Eastham and Patrick Woods.—*F. P. M.*

J. turbinata. Wils. E. B. sup. (Turbinate J.)

River bank beyond New Ferry.—*H. F.* Near Bromboro' Pool.—*F. P. M.*

J. Wilsoniana. Nees. (Wilson's J.)

River bank beyond New Ferry.—*F. P. M.*

J. byssacea. Raths. (Bissus J.) Hook. T. 12.

Storeton, at the top of the hill.—*F. P. M.*

J. connivens. Dicks. (Connivent J.) Hook. T. 15.

Heswell Hills, rare.—*F. P. M.*

Genus XXIV.—ALLICULARIA.

A. compressa. Hook. (Compressed J.) Hook. T. 58.

In a stream at Bromboro' Wood, rare.—*F. P. M.*

A. scalaris. Schrad. (Stair A.) Hook. T. 61.

A very abundant species. Fruiting in Rocky Lane, West Derby, in April.—*F. P. M.*

A. crenulata. Smith. (Crenulate A.) Hook. T. 37.

Bidston and Heswell Hills, not common.

A. Taylori. Hook. (Taylor's A.) Hook. T. 57.

In small pools at Bidston, growing on the rocky sides.—*William Skellon.*

A. anomala. Hook. (Anomalous A.) Hook. T. 34.

Moss End Wood, Bold Moss.—*Rev. H. H. Higgins, and F. P. Marrat.*

Genus XXV.—PLAGIOCHILA.

P. asplenoides. Linn. (Asplenium-like P.) Hook. T. 13.

Not uncommon in moist shady woods and hedge banks in Cheshire. This is the giant among our *hepatics.*

P. resupinata. Linn. (Lying down P.) Hook. T. 23.

Bidston Hill.—*F. P. M.*

P. undulata. Linn. (Wavy P.) Hook. T. 22.

Among gorse and heath in the first lane past the quarry at Green Bank, mixed with *Lejunia minutissima.*—*F. P. M.*

P. nemorosa. Linn. (Grove P.) Hook. T. 21.

In very wet dells at Knowsley Woods.—*Rev. H. H. Higgins and F. P. Marrat.*

LICHENS.

SECTION I.—GYMNOCARPI.

ORDER I.—USNEACEÆ.

Genus USNEA.

U. BARBATA. Linn. (Barbed U.) E. B., T. 258. Fig. 2.

VAR. U. PLICATA.

On hazel trees, Clatter Bridge.—*Rev. H. H. Higgins and F. P. Marrat.*

ORDER II.—CORNICULARIACEÆ.

Genus RAMALINA.

R. POLLINARIA. Ach. (Powdery R.) E. B., T. 1607.

On trees near Raby, in a dell.—*Rev. H. H. Higgins and F. P. M.*

R. FARINACEA. Linn. (Flowery R.) E. B., T. 889.

On old trees, not uncommon.—*F. P. Marrat.*

R. FRAXINEA. (Ash Tree R.) E. B., T. 890. VAR.

On willows near the stream crossing the Upton road.—*F. P. Marrat.*

VAR. R. FASTIGIATA.

On trees, common.

R. SCOPULARIA. Dickson. (Sea shore R.) E. B., T. 688.

On rocks near the sea, Hilbre Island.—*Rev. H. H. Higgins;* Eastham, *F. P. Marrat.*

ORDER III.—CETRARIACEÆ.

Genus CETRARIA.

C. GLAUCA. Linn. (Glaucaus C.) E. B., T. 1606.

Bidston and Heswell Hills.—*Rev. H. H. Higgins and F. P. Marrat.*

C. ISLANDICA. Linn. (Iceland C.) E. B., T. 1530.

Bidston and Heswell Hills.—*Rev. H. H. Higgins and F. P. Marrat.*

C. ACULEATA. Ach. (Prickly C.) Ach Prod. 215.

Bidston and Heswell Hills, abundant.—*F. P. Marrat.*

Order IV.—UMBILICARIACEÆ.

Genus UMBILICARIA.

U. PUSTULATA. Linn. (Blistered U.) E. B., T. 1285.

Bidston Hill.—*Rev. H. H. Higgins and F. P. Marrat.*

U. POLYPHYLLA. Linn. (Many leaved U.) E. B , 1282.

Bidston Hill.—*Rev. H. H. Higgins and F. P. Marrat.*

Order V.—PARMELIACEÆ.

Genus PARMELIA.

P. LÆTEVIRENS. Dill. (Pale green P.)

Var. P. HERBACEA.

On trees, not uncommon.—*F. P. Marrat.*

P. PULVERULENTA. Ach. (Powdery P.) E. B., T. 2064.

On old trees, frequently mixed with the next species.—*F. P. Marrat.*

P. STELLARIS. Linn. (Starry P.) Linn. Sp. Plan., 1611.

Old trees.—*F. P. Marrat.*

Var. P. TENELLA. E. B., T. 1351.

Mosely Vale.—*F. P. Marrat.*

P. CERATOPHYLLA. (Horny leafed P.)

On heathy ground, common.—*F. P. Marrat.*

Var. P. PHYSODES. E. B., T. 126.

On walls, Bidston, &c., &c.—*F. P. Marrat.*

P. SAXATILIS. Linn. (Rock P.) E. B., T. 604.

Trees, rocks, walls, and palings, very common, fruit rare; fruiting on the rocks, in the plantation below the Telegraph station, at Bidston. *F. P. Marrat.*

A bright rose coloured little fungus, the *Illospodium roseum*, grows frequently on this lichen.

Var. P. OMPHALODES.

Bidston Hill, plentiful.

P. CONSPERSA. Ach. (Sprinkled P.) E. B., T. 2097.

Bidston Hill. On the rocks and walls.—*F. P. Marrat.*

P. OLIVACEA. Linn. (Olive coloured P.) E B., T. 2180.

Walls, trees, and palings, very common, fruit rare. Fruiting on trees near Sutton, and on a tree at Bidston.—*F. P. Marrat.*

P. AQUILA. Ach. (Eagle-brown P.) E. B., T. 982.

Hilbre Island.—*Rev. H. H. Higgins.*

P. PARIETINA. Linn. (Wall P.)

On walls, trees, &c., very common.

VAR. P. VIRIDIS, E. B., T. 2148.

This is the green film that is found on almost every tree in the neighbourhood of smoke.

ORDER VI.—LECANOREACEÆ.

Genus LECANORA.

L. ATRA. Ach. (Black L.) E. B., T. 940.

On walls and trees, not uncommon.—*F. P. Marrat.*

L. SUBFUSCA. Linn. (Brownish L.) Linn. Sp. Plan., 1609.

A very common and variable plant.

L. PALLESCENS.

VAR. L. PARELLA. E. B., T. 727.

Old walls, &c., not uncommon.

L. VARIA. Ehrh. (Variable L.) E. B., T. 1666.

On palings.—*F. P. Marrat.*

L. ABELLLA. Persoon. (Whitish L.) E. B., T. 2154.

On trees.—*F. P. Marrat*

L. VITELLINA. Ehrh. (Yolk L.) E. B., T. 1792.

On a wet wall at the Red Noses.—*F. P. Marrat.*

L. SAXICOLA. Ach. (Rock L.) E. B., T. 1695.

On walls, not common, Bidston, Storeton. On the wall opposite Greenbank road; in Smithdown Lane.

L. HÆMATOMMA. Ach. (Red mouth L.)

On wall, Bidston and West Kirby.—*F. P. Marrat.*

Genus URCEOLARIA.

U. SCRUPOSA. Ach. (Rugged U.) E. B., T. 266.

On walls, trees, &c., not uncommon.—*Rev. H. H. H. and F. P. M.*

ORDER VII.—LECIDEACEÆ.

Genus LECIDEA.

L. CÆRULEO-NIGRICANS. (Blackish-green L.) E. B., T. 1139.

Bidston Hill.—*Rev. H. H. Higgins and F. P. Marrat.*

L. CONFLUENS. Weber. (Confluent L.) E. B., T. 1964.

On rocks and stones, common.

L. PUNCTATA.

VARS. L. PARASEMA, AND L. PUNCTIFORMIS.

On trees common.

L. ABIETINA. Ach. (Fir L) E. B., T. 168.

On decayed wood at Bidston Hill.—*F. P. Marrat.*

L. RIVULOSA. Ach. (Rivulet L.) E. B., T. 1737.

Bidston Hill.—*F. P. Marrat.*

L. TRIPTOPHYLLA. Schrad. (Jagged-leaf L.) E. B., T. 2128.

On the bark of oak trees, Bromboro' woods.—*F. P. Marrat.*

L. DUBIA (Doubtful L.)

On Fir trees, Raby.—*F. P. Marrat.*

L. LUCIDA. Ach. (Shining L.) E. B., T. 1550.

On sandstone rocks.—*Sir J. E. Smith, in Hooker.*

L. ÆRUGINOSA. Schaer. (Rusty L.) E. B., T. 372.

Flaybrick hill.—*F. P. Marrat.*

L. ANOMALA.

VAR. L. GRIFFITHII. (Griffith's L.) E. B., T. 1735.

On the smooth bark of trees in woods.—*F. P. Marrat.*

L. CONGLOMERATA. Ach. E. B., T. 1772.

On rock and wall, Bidston.—*F. P. Marrat.*

L. CONCENTRICA. (The ringed L.)

On a wall between Broadgreen and Roby.—*F. P. Marrat.*

L. SPHÆROIDES.

VAR. L. MUSCORUM. E. B., T. 2217.

On moss on walls.—*F. P. Marrat.*

VAR. L. VIRIDESCENS. E. B., T. 2699.

On moss on walls.—*F. P. Marrat.*

L. FERRUGINEA. Hud. (Rust L.)

On walls and trees.—*F. P. Marrat.*

L. CANESCENS. Ach. (Hoary L.) E. B., T. 582.

On walls and trees, West Kirby.—*F. P. Marrat.*

ORDER VIII.—GRAPHIDEACEÆ.

Genus OPEGRAPHA.

O. SAXATILIS. (The stone O.) E. B., T. 2345.

On walls near West Kirby.—*F. P. Marrat.*

O. VARIA.

VAR. O. NOTHA. E. B., T. 1890.

On rugged bark of Oaks, Bromboro' wood.—*F. P. Marrat.*

O. ATRA. Ach. (Black O.) E. B., T. 1753.

On smooth bark common.—*F. P. Marrat.*

O. VULGATA. Ach. (Common O.) E. B., T. 1811.

Eastham, &c.—*F. P. Marrat.*

O. HERPETICA. Ach. (Eruption O.)

On beech bark, Bromboro' wood.—*F. P. Marrat.*

Genus GRAPHIS.

G. PULVERULENTA. Ach. (Powdery G.) E. B., T. 1754.

Bromboro' wood.—*F. P. Marrat.*

G. SERPENTINA. Ach. (Serpentine G.) E. B., T. 1755.

Bromboro' wood.—*F. P. Marrat.*

Genus ARTHONIA.

A. ASTROIDES. Ach. (Star A.) E. B., T. 1847.

On smooth bark.—*F. P. Marrat.*

A. EPIPASTA.

VAR. A. MICROSCOPICA. E. B., T. 1911.

On trees, Patrick wood.—*F. P. Marrat.*

A. LURIDA. Ach. (Shining A)

On trees, Cheshire.—*F. P. Marrat.*

ORDER IX.—CALICIACEÆ.

Genus CALICIUM.

C. HYPERELLUM. Ach. (Bark C.) E. B., T. 1832.

In the clefts of oak bark, Bromboro' wood.—*Rev. H. H. Higgins and F. P. Marrat.*

C. TURBINELLUM. Ach. (Board C.) E. B., T. 1540.

On *Pertusaria communis*, Bromboro' wood.—*F. P. Marrat.*

ORDER X.—CLADONIACEÆ.

Genus STEROCAULON.

S. PASCHALE. Linn. (Easter S.) E. B., T. 282.

On walls, Rainhill.—*Rev. H. H. Higgins.*

Genus BÆOMYCES.

B. ROSEUS. Ach. (Rose B.) E. B., T. 572.

On stones and on the adjacent ground in a wood at Woolton.—*Rev. H. H. Higgins and F. P. M.* A wall, Eastham wood.—*F. P. M.*

Genus CLADONIA.

C. EXTENSA. Floark. (Dilated C.)

On walls and heaths, common.—*F. P. Marrat.*

C. DIGITATA. Floark. (Fingered C.)

Bidston hill.—*F. P. Marrat.*

C. PYXIDATA. Linn. (Cup C.)

Heathy ground, very common.

C. FIMBRIATA. Linn. (Fringed C.)

Heathy ground, very common.

C. ANOMÆUS. E. B., T. 1867.

In wet places on heaths and bogs.—*F. P. Marrat.*

C. SQUAMMOSA. (Scaly C)

On walls, Raby, Bidston, &c.—*F. P. Marrat.*

VAR. C. FUNGIFORMIS, E. B., T. 1796.

On the ground, Bromboro' wood.—*F. P. Marrat.*

C. ALCICORNIS. Ach. (Helk's horn C.)

Heathy ground.—*F. P. Marrat.*

C. CERVICORNIS. Ach. (Stag's horn C.) E. B., T. 2574.

Heathy ground.—*F. P. Marrat.*

C. GRACILIS. Linn. (Slender C.) Linn. Spec. Plan., 1619.

In the plantation on the east side of Bidston Hill.—*F. P. Marrat.*

C. RANGIFERINA. Linn. (Rein Deer C.) E. B., T. 173.

Elevated ground such as Bidston, Heswell, &c.—*F. P. Marrat.*

C. FURCATA. Hud. (Forked C.) Hud., F. Ang., 556.

Elevated ground such as Bidston, Heswell, &c.—*F. P. Marrat.*

ORDER XI.—COLLEMACEÆ.

Genus COLLEMA.

C. SINUATA. Hud. (Jagged C.) E. B., T. 772.

On a wet clay bank beyond the railway bridge, Lower Bebbington.—*Rev. H. H. Higgins and F. P. Marrat.*

C. GRANULOSA. Hoff. (Grunulous C.) Fl. Dan., 462.

Southport.—*F. P. Marrat.*

Section II.—ANGIOCARPI.

Order XII —ENDOCARPACEÆ.

Genus PERTUSARIA.

P. communis. Linn. (Common P.) E. B., T. 677.

On trees, common.—*F. P. Marrat.*

The old *Variolaria faginea* is a varioloid state of this species.

Genus PYRENULA.

P. maura. Ach. (Moor P.) E. B., T. 2456.

On the rocks of the Red Noses.—*P. F. Marrat.*

P. nigrescens. Pers. (Black P.) Bohl. 6n. 41.

On stone walls near the sea, Hoylake, West Kirby, &c.—*F. P. Marrat.*

P. nitida. Weig. (Shining P.) E. B., T. 2607.

On the bark of Beech trees, Bromboro' woods.

Order XIII.—VERRUCARIACEÆ.

Genus VERRUCARIA.

V. gemmata. Ach. (Gemmed V.) E. B., T. 246.

On an old poplar near Woodchurch.—*F. P. Marrat.*

V. cinerea. Persoon. (Ash coloured V.) E. B., T. 1892.

On the smooth bark of Birch trees, Bromboro' woods.—*F. P. Marrat.*

V. epidermidis. (Bark V.) E. B., T. 1848.

On the smooth bark of Birch trees, Bromboro' woods.—*F. P. Marrat.*

V. muralis. (Wall V.) E. B., T. 2647.

On the mortar of walls.—*F. P. Marrat.*

V. patula. Leigh. (The open V.) Leighton, Plate 26, Fig. 1.

On the mortar of walls.—*Rev. H. H. Higgins.*

Order XIV.—LICHINEÆ.

Genus LICHINA.

L. confinis. Ach. (Dwarf L.) E. B., T. 2573.

Hilbre Island.—*F. P. Marrat.*

L. pygmæa. Hud. (Pigmy S.) E. B., T. 1322.

On tidal rocks not uncommon.—*F. P. Marrat.*

MONOGRAPHS

ON THE

NATURAL HISTORY

OF

LIVERPOOL AND ITS VICINITY.

EXTRACTED FROM THE PUBLISHED PROCEEDINGS OF THE
LITERARY AND PHILOSOPHICAL SOCIETY OF LIVERPOOL.

[TO BE USED AS A TITLE PAGE, WHEN THE SEVERAL ARTICLES ARE BOUND TOGETHER.]

[redacted]

PROCEEDINGS

OF THE

RY AND PHILOSOPHICAL SOCIETY

OF

LIVERPOOL,

DURING THE

FTIETH SESSION, 1860-61.

No. XV.

LIVERPOOL:
FOR THE MEMBERS OF THE SOCIETY,
THOMAS BRAKELL, 7, COOK STREET.

1861.

This Volume has been edited by the Hon. Secretary.

The Authors have usually revised their papers.

The Authors alone are responsible for facts and opinions.

The Society exchanges Proceedings with other publishing bodies, through the Secretary, from whom back numbers may be obtained.

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ON THE SOCIETY'S ROLL AT THE CLOSE OF THE 50th SESSION.

Those marked † are Original Members of the Society.

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Oct. 11, 1833 Aikin, James, Esq., 2, *Drury-lane*, and 4, *Gambier-terrace.*
Dec. 10, 1860 Alexander, James, 8, *York Buildings*, *Dale-street*, and 24, *Bedford-street South.*
Jan. 8, 1861 Anderson, David, 7, *Church-street*, *Egremont.*
Dec. 11, 1854 Andrew, John, *Fenwick chambers*, and *Sandown-park*, *Wavertree.*

*Nov. 28, 1853 Archer, Thomas Croxen, *Industrial Museum of Scotland*, *Edinburgh.*

Nov. 18, 1852 Atkin James, 190, *Grove-street.*

Feb. 22, 1855 Avison Thomas, F.S.A., 18, *Cook-street*, and *Fulwood-park*, *Aigburth.*

Dec. 10, 1860 Baar, Rev. Hermann, Ph.D., 15, *Sandon street.*

May 1, 1854 Bahr, George W., 4, *Cable-street*, and 2, *South-hill Grove*, *Aigburth.*

Oct. 29, 1860 Banister, Rev. W., B.A., Hon. Secretary to the Liverpool Naturalists' Field Club, *St. James' Mount.*

Oct. 31, 1859 Batty, Thomas, M.R.C.S., *Greenfield House, Liscard-rd.*

March 9, 1857 Bell, Christopher, *Moor-st.*, and 60, *Bridge-st.*, *Birkenhead.*

Feb. 6, 1854 Bennett, William, 65, *Sir Thomas's Buildings*, and 109, *Shaw-street.*

Oct. 31, 1859 Birch, James, 13, *Rumford-place*, and 7, *Upper Baker-st.*

Feb. 4, 1856 Bird, W. Vallentine, M.D. Aberd., *Seacombe.*

April 15, 1861 Blake, James, 63, *Kitchen-street*, and 45, *Canning-street.*

Oct. 31, 1859 Bloxam, Frederick William, *Liverpool and London Insurance Buildings, Exchange.*

Nov. 7, 1834 Boult, Francis, 26, *Chapel-street*, and 15, *Devonshire-place*, *Claughton.*

*Mar. 6, 1835 Boult, Swinton, 1, *Dale-street*, and 3, *Bedford-street South.*

Nov. 13, 1854 Bretherton, Edward, F.G.S., 21, *Harrington-street*, and 47, *Hamilton-square*, *Birkenhead.*

Oct. 21, 1844 Bright, Samuel, Esq., 1, *North John-street*, and *Sandheys*, *Mill-lane*, *West Derby.*

*Jan. 8, 1855 Brockholes, James Fitzherbert, *Puddington Old Hall*, *near Neston.*

May 5, 1851 Brougham, James Rigg, Barrister-at-Law, Registrar Court of Bankruptcy, *Eldon Chambers*, 20, *South John-street*, and 3, *St. Aidan's-terrace*, *Claughton.*

May 3, 1857 Burton, Rev. Charles Henry, M.A., 1, *Sandon-terrace.*

*May 1, 1848 Byerley Isaac, F.L.S., F.R.C.S., *Victoria road*, *Seacombe.*

Dec. 1, 1851 Clare, John Leigh, 11, *Exchange-buildings*, and 22, *Richmond-terrace*, *Breck-road.*

Oct. 31, 1859 Clark, Charles, 17, *North John street*, and *Rock Ferry.*

Jan. 26, 1857 Clay, William, 97, *Sefton-street*, and 4, *Parkhill-road.*

Nov. 16, 1857 Cooper, Joseph, *Oak House*, *Aigburth.*

May 31, 1858 Collingwood, Cuthbert, M.A., M.B., Oxon, M.R.C.P., F.L.S., Lect. on Botany, Royal Infirmary Sch. of Med.; Professor of Physiology, Queen's Coll.; Phys. to the Northern Hospital; 15, *Oxford-street.*

Jan. 22, 1850 Cox, Henry, 19, *Brunswick-street*, and *Poplar-rd.*, *Oxton.*

Jan. 26, 1857 Dadabhai Naoroji, Professor of Gujarati, London University, 32, *Great St. Helens, London, E.C.*

*April 6, 1840 Dickinson, Joseph, M.A., M.D. Dub. and Cantab. F.R.C.P., F.R.S., M.R.I.A., F.L.S., 92, *Bedford-street South.*

Dec. 12, 1859 Dobson, Thomas, B.A., St. John's Coll., Cantab., Head Master of the School-frigate "Conway," 1, *Eldon-terrace, South Tranmere.*

Nov. 27, 1848 Dove, Percy Matthew, F.S.S., 1, *North John-street*, and 49, *Hamilton-square, Birkenhead.*

Jan. 23, 1848 Drysdale, John James, M.D. Edin., M.R.C.S. Ed., 44, *Rodney-street.*

Feb. 4, 1856 Duckworth, Henry, F.L.S., F.R.G.S., F.G.S., 5, *Cook-street*, and 2, *Gambier-terrace.*

Jan. 9, 1837 Duncan, William Henry, M.D. Edin., Medical Officer of Health, 2, *Cornwallis-street*, and 17, *Peel-terrace, Upper Canning-street.*

April 29, 1861 Eccles, Alex., B.A. Cantab., *Huyton.*

*Nov. 27, 1848 Edwards, John Baker, Ph.D. Gies., F.C.S., Lect. on Chemistry, Liverpool Royal Infirmary Sch. of Med., *Royal Institution Laboratory*, and 46, *Nelson-street.*

Dec. 15, 1856 England, Rev. James, M.A., 158, *Chatham street.*

Nov. 18, 1850 Evans, Henry Sugden, F.C.S., 52, *Hanover-street*, and 94, *Huskisson-street.*

April 30, 1860 Fabert, John Otto William, 1, *Parliament-street*, and 3, *St. James' Mount.*

*Dec. 14, 1846 Faram, John, 8, *Railway Cottages, Edge-hill*, and *Lime-street Railway-station.*

*Dec. 13, 1852 Ferguson, William, F.L.S., F.G.S., 62, *Gresham House, Old Broad-street, London, E.C.*

*April 3, 1837 Fletcher, Edward, 4, *India-buildings*, and 31, *High Park-street.*

Feb. 6, 1854 Fletcher, Fred. Dicker, M.R.C.S., Lect. on Anatomy and Physiology, Royal Infirmary Sch. of Med.; Surg. Workhouse Hospital; 15, *Upper Duke-street.*

*Mar. 19, 1855 Foard, James Thomas, 12, *Salisbury-street, Strand, London.*

*Feb. 6, 1854 Gee, Robert, M.D.Heidelb., M.R.C.P., M.R.C.S., Lect. on Patholog. Anat. Royal Infirmary Sch. of Med.; Physician Workhouse Hospital; 10, *Oxford-street.*

March 4, 1861 Ginsburg, Rev. C. D., 10, *Rake-lane.*

March 3, 1856 Grainger, John, B.A., 4, *Chapel-street*, and *Belfast.*

Nov. 14, 1853 Greenwood, Henry, 32, *Castle-st.*, and *Roseville, Huyton.*

Nov. 30, 1857 Grimmer, William Henry, 15, *Cable-st.*, and 64, *Grove-st.*

Jan. 22, 1855 Hakes, James, M.R.C.S., Surgeon to the Northern Hospital, 12, *Maryland-street.*

Nov. 30, 1857 Hall, Robert Henry, 16, *Hackin's Hey*, and *Sandfield House, Whiston.*

Oct. 18, 1858 Hamilton, Robert Gordon, 12, *Tithebarn-street*, and 99, *Bedford-street South.*

*Jan. 21, 1856 Hardman, Lawrence, *York-buildings, Sweeting-street*, and *Rock-park, Rock-ferry.*

Nov. 14, 1857 Hartley, John Bernard, *Coburg Dock*, and *Allerton.*

*Mar. 7, 1842 Heath, Edward, Esq., *Orange-court*, 37, *Castle-street*, and *St. Domingo-grove*, 114, *Breckfield-rd. N., Everton.*

Dec. 12, 1855 Hess, Ralph, *Albany, Oldhall-street*, and 17, *Upper Duke Street.*

Dec. 28, 1846 Higgins, Rev. H. H., M.A., Cantab., F.C.P.S., *Rainhill.*

*Oct. 31, 1836 Higginson, Alfred, M.R.C.S., Hon. Lect. on Anatomy, Liverpool Soc. of Fine Arts; Surg. Southern Hosp., 44, *Upper Parliament-street.*

Mar. 4, 1861 Hindley, Rev. H. J., M.A., 3, *Grecian-terrace, Everton.*

Jan. 12, 1857 Holden, E. Erasmus, *Appleton-in-Widnes, Warrington.*

Nov. 13, 1854 Holland, Charles, 17, *Tower-buildings North*, and 38, *Rodney-street.*

Mar. 22, 1847 Horner, Henry P., 10, *Basnett-street*, and 5, *Devonshire-road, Prince's-park.*

Nov. 4, 1850 Howson, Rev. John Saul, M.A. Trin. Col. Cantab. Principal of the Collegiate Institution, *Shaw-street*, and *Dingle-park, Dingle-lane.*

Dec. 27, 1841 Hume, Rev. Abrah., D.C.L. Dub., LL.D. Glas., F.S.A., 24, *Clarence-street, Everton.*

*Nov. 13, 1854 Hunter, John, Memb. Hist. Soc. Pennsylvania, *Herne, Charlotte-town, Prince Edward's Island.*

Jan. 26, 1857 Hutton, David, 3, *St. George's Crescent.*

*Apr. 29, 1850 Ihne, William, Ph.D. Bonn, 316, *Upper Parliament-st.*

Feb. 23, 1857 Imlach, Henry, M.D. Edin., 1, *Abercromby-square.*

*Oct. 21, 1844 Inman, Thomas, M.D. London, M.R.C.P., Phys. Royal Infirmary, 12, *Rodney-street,* and *Spital, Cheshire.*

Jan. 23, 1854 Jones, John, 28, *Chapel-street,* and 70, *Rodney-street.*

*April 4, 1852 Jones, Morris Charles, *Queen's Insurance-buildings,* and 75, *Shaw-street.*

May 5, 1851 Jones, Roger Lyon, *Liverpool and London Chambers, Exchange,* and 6, *Sunnyside, Prince's-Park.*

Nov. 26, 1860 Kenworthy, James, M.D., *Parkgate, Cheshire.*

Feb. 19, 1855 King, Alfred, 14, *Newington,* and 9, *Netherfield-rd. South.*

Oct. 29, 1860 Kirby, Frederick, *Falkner-st.,* and *Free Public Museum.*

Jan. 10, 1848 Lamport, William James, 21, *Water-street,* and 5, *Beech-terrace, Beech-street, Fairfield.*

*Jan. 14, 1839 Lassell, William, F.R.SS.L. and E., F.R.A.S., 27, *Milton-street,* and *Broadstones, Sandfield-park, West Derby.*

Oct. 21, 1844 Lear, John, 1, *North John-street,* and 22, *Holland-terrace, Duke-street, Edge Hill.*

Feb. 23, 1857 Lewis, James, *Liverpool and London Chambers, Exchange,* and 1, *Parkfield-road, Prince's-park.*

Dec. 10, 1860 Leyland, Joseph, *Williamson-square.*

Feb. 22, 1858 Little, Robert, *Liverpool and London Chambers, Exchange,* and *Rainhill.*

Oct. 20, 1859 M'Andrew, James Johnston, 5, *North John-street,* and *Greenfield Cottage, Bromborough.*

*Oct. 21, 1844 M'Andrew, Robert, F.R.S., F.L.S., *Allhallows-chambers, Lombard-street, London.*

March 9, 1857 MacFie, Robert Andrew, 30, *Moorfields,* and *Ashfield Hall, Neston.*

Dec. 11, 1854 M'Ilveen, Alexander, Principal Liverpool Institute, 9, *Sandon-terrace.*

Jan. 21, 1861 MacNaught, Rev. John, M.A., 63, *Everton-road.*

April 4, 1853 Marrat, Frederick Price, 22, *Arcade*, and 2, *Peverill-terrace, Edge-lane.*

Jan. 21, 1839 Martin, Studley, *Exchange chambers*, and 109, *Bedford-st.*

Feb. 5, 1844 Mayer, Joseph, F.S.A., F.R.A.S., F.E.S., 68, *Lord-street.*

April 1, 1861 Melly, George, 90, *Chatham-street.*

May 2, 1853 Milner, Rev. James Walker, M.A., 1, *Devonshire-terrace*, 324, *Upper Parliament-street.*

Oct. 31, 1859 Moore, Thomas John, Corr. Mem. Z.S., Curator Free Public Museum, *William Brown-street.*

Jan. 8, 1855 Morton, George Highfield, F.G.S., 9, *London-road.*

April 16, 1849 Moss, Rev. John James, B.A., *Upton, Cheshire.*

Oct. 29, 1850 Mott, Albert Julius, 19, *South Castle-street*, and *Holt-hill.*

April 3; 1854 Mott, Charles Grey, 27, *Argyle-street, Birkenhead*, and 2, *Shewell's-road, Holt-hill.*

Oct. 20, 1856 Nevins, John Birkbeck, M.D., Lond., M.R.C.S., Lect. on Materia Medica, Roy. Infirmary School of Medicine, 25, *Oxford-street.*

Dec. 15, 1851 Newlands, James, F.R.S.S.A., Borough Engineer, 2, *Cornwallis-street*, and 4, *Clare-terrace, Duke-st. North, Edge Hill.*

*Nov. 29, 1847 Nisbet, William, L.F.P.S.G , *Church-st., Egremont.*

*Oct. 15, 1855 North, Alfred, *Salcombe Hill, Sidmouth, Devonshire.*

Dec. 28, 1846 Picton, James Allanson, F.S.A., 11, *Dale-st.*, and *Sandy-knowe, Wavertree.*

Feb. 6, 1854 Prange, F., *Royal Bank-buildings, Dale-street*, and 2, *Grove-park, Lodge-lane.*

Jan. 8, 1850 Ramsay, Rev. Arthur, M.A. Trin. Coll. Cantab., *High-fields, Eaton-road, West Derby.*

†Mar. 13, 1812 Rathbone, William, 20, *Water-street*, and *Greenbank, Wavertree.*

Nov. 12, 1860 Rathbone, Philip H., 4, *Water-street*, and *Greenbank-cottage, Wavertree.*

*Jan. 7, 1856 Rawlins, Charles Edward, Jun., 23, *Cable-street*, and 1, *Windermere-terrace, Prince's-park.*

*Nov. 17, 1851 Redish, Joseph Carter, 18, *Chapel-street*, and *Wavertree.*

Feb. 6, 1854 Rees, Wm., Poor-Law Auditor, *Old Trafford, Manchester.*

Mar. 20, 1854 Rigge, Thomas, 64, *Rodney-street.*

Nov. 2, 1840 Robberds, Rev. John, B.A., 58, *High Park-street.*

Oct. 18, 1858 Roberts, John, 25, *South John-street*, and *Pilgrim-street, Birkenhead.*

Jan. 21, 1861 Roberts, Henry Benjamin, *Parker-street.*

April 18, 1854 Rowe, James, 2, *Chapel-walks*, and 51, *Shaw-street.*

May 26, 1856 Samuelson, Newton, F.C.S., 3, *Hackin's-hey*, and 43, *Hope-street.*

April 6, 1846 Scholfield, Henry Daniel, M.D. Oxon, M.R.C.S., 14, *Hamilton-square, Birkenhead.*

†Mar. 13, 1812 Smith, James Houlbrooke, Esq., 28, *Rodney-street*, and *Green-hill, Allerton.*

Nov. 12, 1860 Spence, Charles, President of the Chatham Society, *Oldhall-street*, and 21, *Catharine-street.*

Dec. 14, 1857 Steele, Robert Topham, 4, *Water-street*, and 8, *Bedford-street South.*

Oct. 18, 1858 Stuart, Richard, 10, *Exchange-street East*, and *Brooklyn Villa, Breeze-hill, Walton.*

*Feb. 19, 1855 Taylor, John Stopford, M.D. Aberd., F.R.G.S., 1, *Springfield, St. Anne-street.*

Jan. 23, 1843 Taylor, Robert Hibbert, M.D. Edin., L.R.C.S. Ed. Lect. on Ophthalmic Medicine, Royal Infirmary School of Medicine, 1, *Percy street.*

Dec. 11, 1854 Thompson, Samuel H., Esq., *Thingwall Hall, Knotty Ash.*

Nov. 17, 1856 Tinling, Chas., 60, *Castle-st.*, and 17, *Clarence-st., Everton.*

Nov. 26, 1860 Tooke, William H., *Church-street*, and *Waterloo.*

Dec. 1, 1851 Towson, John Thomas, F.R.G.S., Scientific Examiner, Sailors' Home, 47, *Upper Parliament-street.*

*Feb. 19, 1844 Turnbull, James Muter, M.D. Edin., M.R.C.P., Phys. Royal Infirmary, 86, *Rodney-street.*

Nov. 16, 1857 Tymbas, Gregory, *York Buildings*, 14, *Dale-street*, and *Edge-lane Hall.*

Oct. 21, 1844 Vose, James Richard White, M.D. Edin., F.R.C.P., Phys. Royal Infirmary, 5, *Gambier-terrace.*

Oct. 29, 1860 Walker, David, M.D., F.L.S., F.R.G.S., M.R.I.A., late Surgeon and Naturalist to the "Fox," 8, *Beaufort-terrace, Seacombe.*

Mar. 18, 1861 Walker, Thomas Shadford, M.R.C.S., 54, *Rodney-street.*
Oct. 21, 1844 Walmsley, Joshua, 50, *Lord-street.*
Oct. 18, 1858 Watkins, John W., M.D., *Newton-in-the-Willows, near Warrington.*
Oct. 29, 1855 Wilks, William George, 1, *Dale-st.*, and *Mill-bank, Anfield.*
Mar. 18, 1861 Wood, Geo. S., *Belle-vue Road, Wavertree*, and 20, *Lord-st.*

CORRESPONDING MEMBERS.

LIMITED TO FIFTY.

Nov. 6, 1812 Peter Mark Roget, M.D. Edin., F.R.C.P., F.R.S., F.G.S., F.R.A.S., F.R.G.S., &c., 18, *Upper Bedford-place, London.*
Feb. 2, 1815 George Cumming, M.D. Edin., M.R.C.P., *Denbigh.*
Feb. 12, 1819 John Stanley, M.D. Edin., *Whitehaven.*
Dec. 5, 1821 Rev. Brook Aspland, *Dukinfield, Cheshire.*
Jan. 4, 1833 The Right Hon. Dudley Ryder, Earl of Harrowby, K.G., D.C.L., F.R.S., *Sandon-hall, Staffordshire*, and 39, *Grosvenor-square, London, W.*
Jan. 4, 1833 James Yates, M.A., F.R.S., F.L.S., F.G.S., &c., *Lauderdale House, Highgate, London.*
†April 12, 1833 Thomas Stewart Traill, M.D. Edin., F.R.C.P.E., F.R.S.E., F.G.S., &c., Professor of Medical Jurisprudence in Univer. Edin., *Edinburgh.*
†Jan. 2, 1835 John Ashton Yates, F.R.G.S., *Bryanston-square, London.*
Jan. 2, 1835 George Patten, A.R.A., 21, *Queen's-road West, Regent's-park, London.*
May 1, 1835 William Ewart, M.P., *Cambridge-square, Hyde-park, London.*
Nov. 2, 1835 The Right Hon. Lord Brougham and Vaux, M.A., D.C.L., F.R.S., Chancellor of the University of Edinburgh, 4, *Grafton-street, London, W.*, and *Brougham Hall, Penrith.*
Feb. 20, 1837 The Most Noble William, Duke of Devonshire, K.G., M.A., F.R.S., F.G.S., &c., *Devonshire House, London, W.*, and *Chatsworth, Derbyshire.*

Nov. 12, 1838 Geo. Biddell Airy, M.A., D.C.L., F.R.S., Hon. F.R.S.E., Hon. M.R.I.A., V.P.R.A.S., F.C.P.S., &c., Astronomer Royal, *Royal Observatory, Greenwich.*

Feb. 24, 1840 James Nasmyth, F.R.A.S., *Penshurst, Kent.*

Nov. 2, 1840 Richard Duncan Mackintosh, L.R.C.P., *Exeter.*

Nov. 15, 1841 Charles Bryce, M.D. Glasg., Fell.F.P.S.G., *Brighton.*

Oct. 21, 1844 J. Beete Jukes, M.A., F.R.S., M.R.I.A., F.G.S., Local Director of the Geological Survey of Ireland, 51, *Stephen's-green, Dublin.*

Oct. 21, 1844 T. P. Hall, *Coggeshall, Essex.*

Oct. 21, 1844 Peter Rylands, *Warrington.*

Oct. 21, 1844 John Scouler, M.D., LL.D., F.L.S., Prof. of Mineralogy, R.D.S., *Dublin.*

Oct. 21, 1844 Thomas Rymer Jones, F.R.S., F.Z.S., F.L.S., *King's College, London.*

Oct. 21, 1844 Robert Patterson, F.R.S., M.R.I.A., *Belfast.*

Oct. 21, 1844 Professor Alger, *Boston, U.S.*

Oct. 21, 1844 Sir Charles Lemon, Bart., M.A. Cantab., F.R.S., F.G.S., *Penrhyn, Cornwall.*

1844 William Carpenter, M.D. Edin., F.R.S., F.L.S., F.G.S., *Registrar London University.*

1847 Sir William Rowan Hamilton, LL.D., Hon. F.R.S.E., M.R.I.A., F.R.A.S., F.C.P.S., Astronomer Royal for Ireland, *Dublin.*

Nov. 26, 1848 Rev. Thomas Corser, M.A.., *Strand, Bury.*

Jan. 8, 1850 Rev. St. Vincent Beechy, M.A. Cantab., *Worsley, near Eccles.*

Jan. 27, 1851 James Smith, F.R.SS.L., and E., F.G.S., F.R.G.S., *Jordan-hill, Glasgow.*

Feb. 24, 1851 Henry Clarke Pidgeon, *London.*

Feb. 24, 1851 Rev. Robert Bickersteth Mayor, M.A. Cantab., Fell. St. John's Coll. Cantab., F.C.P.S., *Rugby.*

Jan. 26, 1852 William Reynolds, M.D., *Coed-du, Denbighshire.*

Oct. 17, 1853 Rev. James Booth, LL.D., F.R.S., &c., *Stone, near Aylesbury.*

Feb. 23, 1857 Thomas Jos. Hutchinson, F.R.G.S., F.R.S.L., F.E.S., H.B.M. Consul, *Fernando Po.*

Oct. 15, 1860 William Brown, Lieut-Col. 5th L.A.V., *Richmond-hill, Liverpool.*

TREASURER'S ACCOUNTS, 1859-60

Dr. *Literary and Philosophical Society, in Account with* Isaac Byerley, *Treasurer, to October*, 1860. Cr.

	£	s.	d.
To paid Greenwood—Printing "Proceedings"	59	5	2
" Tinling—Reporting	10	10	0
" Do. Printing	12	16	9
" Secretary—Editorial Expenses	10	10	0
" Do. Expenses of Management:— Delivery of Circulars, postage of Parcels, Letters, and Proceedings; Envelopes, general Stationery, and Incidentals......	16	3	0
" Do. Balance due at last Annual Meeting	2	2	6
" Expenses of Soireé;—Music, Door-keepers, Decorations, &c.	4	0	6
" Mrs. Johnson, for Tea, Coffee, Candles, &c., February 4th (including Soireé, Oct 31)..	7	2	8
" Do. Sept. 25th..................	6	7	8
" Share of Gas-fittings in Royal Institution..	9	8	8
" Collector's Commission, &c.	6	18	0
	£144	10	11
To Balance carried down..............	187	2	9
	£332	2	8

	£	s.	d.	£	s.	d.
By Balance from last account:—						
" Dock Bond	£150	0	0			
" In Treasurer's hands	57	19	1			
				207	19	1
" Subscriptions (Annual)				87	3	0
" Do. (Arrears)				18	18	0
" Entrance Fees				4	4	0
" Interest on Dock Bond				5	18	4
" Cash in Bank				10	4	3
				£332	2	8
Balance brought down—						
Dock Bond	£150	0	0			
In Treasurer's hands	37	2	9			
Exclusive of Arrears	£187	2	9			

October, 1860. *Errors Excepted*,

Audited and found correct, Isaac Byerley, *Treasurer*.

Cuthbert Collingwood, Henry Duckworth, } Auditors.

PROCEEDINGS

OF THE

LIVERPOOL

LITERARY AND PHILOSOPHICAL SOCIETY.

ANNUAL MEETING—FIFTIETH SESSION.

ROYAL INSTITUTION, October 1st, 1860.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

The minutes of the last meeting having been read and signed,

Mr. REDISH, acting for the Secretary, read the following Report from the Council :—

"The Literary and Philosophical Society enters this evening upon its Fiftieth Session, but it does not complete its fiftieth year of existence until the 21st of February, 1862. It was founded in March, 1812, and thus held part of two Sessions in its first year. It will rest with the Society to celebrate this event at the proper time, by a suitable commemoration, should it be thought desirable. The work of the past Session has been for some time before the members, in a permanent form, and the Council refer with satisfaction to the volume of Proceedings, which will fairly maintain the claims of the Society as a body seeking to foster original inquiry and learned research. Considerable expense has been caused by the illustrations, but the Council feel that their value justified the outlay. The various donations which have been received during the past Session, have been acknowledged to their respective donors, and a

complete list is printed in the volume already in the hands of the members.

"The attention of your Council having been drawn to *The Manchester Flora*, by Mr. L. H. Grindon, it was decided to present him with a bound copy of the Society's local Floras, which has accordingly been forwarded to the President of the Manchester School of Medicine, for that purpose.

"During the past year your Society has lost two ordinary members by death—Mr. King Ellison and Mr. J. M. Brighouse—and its distinguished corresponding member, the Rev. Professor Baden Powell. Its number has also been reduced to the extent of thirty by resignations (sixteen) and removals from the roll through the operation of the laws, but it has added nine new members to its ranks; consequently the numerical strength of the Society stands thus:—Ordinary members on the roll at last annual meeting, 150; added by election, 9; removals by death and other causes, 30. Present numbers:—Ordinary members, 129; corresponding members, 40; total, 169.

"The Treasurer's accounts will be laid before you, from which you will perceive that a considerable portion of the Society's funds remain invested on the security of a Dock Bond.

"Your Council desire to draw the attention of the Society to the following Report of the sub-committee of the learned societies, presented at a general meeting of the various councils, held in the Royal Institution, on the evening of the 26th of September:—'Your sub-committee appointed on the 9th of March last, in pursuance of a proposition of William Brown, Esq., to form a special museum for the exhibition of applications of practical science, have held numerous meetings, and have had communications with Mr. Brown, and with the Library and Museum Committee of the Town Council, and have much pleasure in reporting that their labours have

resulted in an arrangement under which they hope that Mr. Brown's wishes will be fully realized, and that his munificence will result in a valuable addition to the public institutions of the town which was not contemplated when the building of the New Library and Museum was commenced. The Town Council have expressed their concurrence by a Resolution which places at your disposal a large space, comprising a ground floor and two galleries. It is as follows, and fully explains your position in regard to this movement:—

"'At a meeting of the Gardens and Library and Museum Committee, held on Friday, the 27th July, 1860 (present, Jas. A. Picton, Esq., chairman, &c.,) a suggestion having been made by Mr. Brown that a portion of the New Museum might be advantageously appropriated for the exhibition of new inventions and improvements of a scientific character, under the management of the learned societies of the town, and Mr. Brown having offered to take upon himself the expense of roofing and making galleries for such purpose, and correspondence and conferences having been held with deputations from the Architectural and Archæological Society, the Chemists' Asssociation, the Historic Society of Lancashire and Cheshire, the Literary and Philosophical Society, and the Polytechnic Society, with that view, the Library and Museum Committee recommend to the Council that a portion of the new building be set apart for the above-mentioned purpose, under the management of a committee of delegates from the above-named societies, who shall be permitted to remove such objects as they may deposit in pursuance of this resolution, such appropriation to continue during the pleasure of the Council, subject to such rules and regulations as the Council may determine upon from time to time. Extracted from the proceedings.—Wm. Shuttleworth, Town-clerk. Approved by the Council, 1st August, 1860.—Wm. Shuttleworth, Town-clerk.'

"It is hardly necessary for your Committee to point out that your retention of this valuable privilege is dependent upon your making such use of it as shall promote the public interests, and that the zealous labours of the Committee of Management, and of the societies will be required to this end. The meetings of the societies will afford opportunities for the elucidation of the objects exhibited, and much additional interest will be reflected upon their proceedings. The building is making rapid progress, and the portion appropriated to the purpose under consideration is expected to be ready about the end of the year. Your sub-committee recommend that the museum shall be called the 'Gallery of Inventions;' that the management of the Gallery of Inventions be vested in a committee, consisting of William Brown, Esq., the founder, and of twenty-five delegates, five to be annually appointed by each of the five societies. That an aggregate meeting of the members of the five societies shall be summoned by the Committee of Management in October of each year, and to them, and to the Library and Museum Committee of the Council, they shall report their proceedings. In conformity with the above, your Council recommend that the election of the five delegates from this Society shall take place this evening, and in future years at the annual meeting of the Society.

"In acknowledgment of Mr. Brown's munificent gift of a Free Public Library to the town, and his provision of a Gallery of Inventions, your Council recommend that he be elected a Corresponding Member of the Society, and that such laws be suspended as may be necessary, for this purpose.

"In conclusion, your Council recommend the following gentlemen for election on the new Council:—Richard Brooke, Esq., F.S.A., Charles H. Clark, Esq., William Ihne, Esq., Ph.D., Dadabhai Naoroji, Esq., James A. Picton, Esq., F.S.A.

"HENRY H. HIGGINS, M.A., *President.*

"ROYAL INSTITUTION, 1st Oct. 1860."

It was moved by the Rev. H. H. HIGGINS, and seconded by Mr. BYERLEY, "That the report now read be adopted." Carried unanimously.

The Treasurer's accounts, which had previously been audited by Dr. Collingwood, and Mr. Duckworth, were then submitted and passed.

The Society next proceeded to ballot for five new members of Council, when the following gentlemen, who were recommended by the retiring Council, were elected:—

Richard Brooke, F.S.A., William Ihne, Ph.D., James Allanson Picton, F.S.A., Prof. Dadabhai Naoroji, Charles H. Clark.

In addition to these, the following nine gentlemen were re-elected from the retiring Council:—

J. Baker Edwards, Ph.D., F.C.S., Isaac Byerley, F.L.S., F.R.C.S., Henry Duckworth, F.R.G.S., F.G.S., J. Birkbeck Nevins, M.D.Lond., C. Collingwood, M.B.Oxon, M.R.C.P., F.L.S., &c., Joseph Carter Redish, George Highfield Morton, F.G.S., David Purdie Thomson, M.D., Rev. J. Robberds, B.A.

A ballot was finally taken for the office-bearers, with the following result:—

President:

[The REV. HENRY H. HIGGINS, M.A.Cantab.]

Vice-Presidents:

J. BAKER EDWARDS, Ph.D., F.C.S.

WILLIAM IHNE, Ph.D.

JAMES ALLANSON PICTON, F.S.A.

Treasurer:

ISAAC BYERLEY, F.L.S., F.R.C.S.

Hon. Secretary:

C. COLLINGWOOD, M.B.Oxon, M.R.C.P., F.L.S., &c.

It having been announced that William Brown, Esq., had expressed his intention to cover in a large area of the New

Museum, for the purpose of exhibiting therein models, inventions, and other objects of scientific interest; and, further, that he wished this "Gallery of Science and Inventions" to be under the direct management of a delegacy from the five learned societies, subject to the control of the Museum Committee of the Town Council, it was proposed by Dr. EDWARDS, and seconded by Mr. BYERLEY, "That five gentlemen be elected by ballot, as delegates from this Society, for the management of the proposed Gallery."

The following gentlemen were therefore elected:—Rev. H. H. Higgins, president, Dr. Collingwood, hon. sec., Dr. Nevins, Mr. A. Higginson, and Mr. H. Duckworth.

The following recommendation from the Council was then entertained:—"That in consideration of the munificent gift of the Free Public Library to the town, it is desirable to elect William Brown, Esq., a Corresponding Member of this Society; and the suspension of such laws as may be necessary, for this purpose."

It was therefore moved by Mr. NISBET, and seconded by Dr. EDWARDS, "That Laws 7, 10, and 11 be suspended, so far as they would interfere with the election of William Brown, Esq., as a Corresponding Member of this Society." This resolution was carried unanimously.

It was further moved by Mr. HIGGINSON, and seconded by Dr. NEVINS, "That William Brown, Esq., be elected a Corresponding Member of this Society." A ballot was then taken, when Mr. William Brown was unanimously elected a Corresponding Member. These proceedings to be confirmed at an Extraordinary Meeting of the Society, to be held on the 15th instant.

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FIRST ORDINARY MEETING,

ROYAL INSTITUTION, October 15th, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The PRESIDENT drew the attention of the Society to the Liverpool Field Naturalists' Club, which had sprung into existence since the last ordinary meeting, and had already become an important and flourishing body. He referred to the interesting excursions which had been conducted by them during the summer, and announced that the first evening meeting of the Club would be held at the Royal Institution, on Monday evening next, when Dr. Dickinson would preside, and Dr. Collingwood, one of the Vice-Presidents, would deliver a lecture on "Marine Zoology."

Dr. IHNE referred to an investigation which had lately been made by M. Lorentz, of Vienna, as to the authenticity of the story of Arnold von Winkelried. He remarked that it has long been admitted on all sides that the story of William Tell is entirely fabulous. It now appears that another Swiss hero has to be removed from the region of history into that of fable. The Battle of Sempach was fought A.D. 1386, against Duke Leopold of Austria, and is said to have been decided in favour of the Swiss by the self-devotion of Arnold von Winkelried, who rushed upon the line of Austrian lances, and, burying as many as he could grasp in his own breast, made a passage for his countrymen. M O. Lorentz, of Vienna, in a recent publication, shows that the oldest records of the battle of Sempach make no mention of Winkelried. Nor is he named in two very old popular songs, or by the

historians Justinger, Russ, and Etterlin. He is likewise ignored by the chronicles of Constance, which date from the beginning of the fifteenth century, and by a MS. Swiss history of the sixteenth century. He is first mentioned in the chronicle of Tchudi, (died 1572,) who draws the story from a popular song. Now this song, as M. Lorentz shows, is not an original, but an expanded version of a song given in Russ's chronicles, and containing no mention whatever of Winkelried, though Russ says it was sung as a song of victory after the battle of Sempach. The destruction of this and similar fables was the duty, though not an agreeable one, of the truthful and accurate historian.

Mr. NISBET exhibited the head and palatal teeth of a species of Parrot-fish, of the genus *Scarus*, (Linn.,) belonging to the hard-finned family *Labridæ* of Cuvier. This curious head was found in the guano at Halabi, one of the Kooria Mooria Islands.

Additions to the local Flora and Fauna having been called for, according to custom, the Secretary submitted a list, furnished by Messrs. F. M. WEBB and H. FISHER, containing notices of many new habitats of interesting plants, as follows:—

RANUNCULUS LENORMANDI.—Frequent about Claughton Village. F. M. W.

RANUNCULUS LINGUA, L.—Ditch behind Pym's Buildings, Oxton-heath. H. F.; and marshy ground between Hoylake and West Kirby. F. M. W. and H. F.

RANUNCULUS AURICOMUS.—Prenton. H. F. and F. P. Marrat.

RANUNCULUS PARVIFLORUS, L.—Left hand side of Upton Road after passing the cutting. F. P. Marrat and H. F.

RANUNCULUS ARVENSIS, L.—Corn field, West Derby. H. F.

Aquilegia vulgaris, L.—Bromborough Wood. W. H Hatcher and H. H. Higgins.

Lepidium Smithii, Hook.—Field between Higher Tranmere and Bebbington; also in a yard off Noctorum Farm, on a bank. F. M. W.

Erysimum cheiranthoides, L.—Cultivated ground, Old Swan. C. S. Gregson. Very sparingly near Sutton. F. M. W.

Sinapis (Diplotaxis) tenuifolia, Br.—South west corner of Birkenhead Park, by old house. The original plants have been destroyed (in September), but not until a portion of the seed had ripened, and, I believe, fallen, so that the plant may again make its appearance in this locality. F. M. W.

Reseda fruticulosa.—Bootle, near the Rimrose. H. F.

Viola palustris, L.—Piece of marshy ground on left hand side of the road running from Upton Road to Dock Cottage Church—plentiful and fine. F. M. W. Raby. H. H. H.

Drosera intermedia, var. coalescens.—Frankby Heath. F. M. W. and H. F.

Silene anglica, L—Very abundant in a rye-field, through which the pathway from Hoylake to West Kirby passes. F. M. W. and H. F.

Sagina subulata.—Frankby Heath. H. F. and F. M. W.

Spergularia media (var. of S. marina.)—Shore near Dingle.

Linum usitatissimum, L.—Rubbish heaps, Canning Street, Birkenhead. F. M. W.

Linum perenne.—Between Heswall and Caldy. H. F. and F. M. W.

Coronopus didyma.—Speke. W. Hitchmough.

Fumaria capreolata, var. pallidiflora.—Hedge near Poolton. H. F. and F. M. W.

Saponaria officinalis.—Wall near Prenton Hall. H. F. and F. P. M. Railway banks near Hightown Station. H. F. and F. M. W.

Viola odorata.—Near Upton Village on road to Moreton. Miss Cooke.

Hypericum elodes.—Side of a large pit on Oxton Heath, above Noctorum Farm, July, 1858. F. M. W. and Dr. Collingwood.

Geranium columbinum.—Near Queen's Ferry. H. F.

Impatiens Noli-me-tangere.—Mount's Wood, near Prenton. Mr. Price. Lane at Oxton. Mr. Price and Dr. Wright.

Genista anglica.—Left hand side of lane from Hale road to shore by Dungeon. F. M. W. Near Barnstone. H. F. and F. M. W.

Medicago denticulata.—A single plant by side of Upton road, near Claughton Village, July, 1859. F. M. W.

Melilotus arvensis.—Seaforth. H. F. By Bromborough Pool Candle Works. Mr. Hatcher. On a piece of waste ground by railway crossing Birkenhead Docks. F. M. W.

Melilotus vulgaris.—Macadamized road, Claughton, 1858. H. F. Together with the last by Birkenhead Docks. F. M. W.

Ornithopus compressus.—A south of Europe plant, with the above on ballast heaps, Birkenhead Docks. H. F. and F. M. W.

Trifolium hybridum.—Crosby sand-hills. H. F. Near Arrow Brook, Cheshire. F. M. W. and H. F., and near Knotty Ash. H. F. (Sown in some places as fodder, and escaped from cultivation.)

Trifolium striatum.—Plentiful by road side, near Arrow Brook, Cheshire. H. F. and F. M. W. A single plant at top of Back Lane, at Wallasey, 1858. F. M. W. Rainhill. H. H. H.

Trifolium pratense.—*White flowered* var., near Hoylake. B. Cooke. Plentiful in a field in Ness. F. M. W.

Trifolium repens.—Proliferous variety, common.

Lotus corniculatus, var. tenuis.—Moist piece of ground near Huyton Quarry. F. M. W.

Agrimonia odorata.—Brought by herbalists to market from Southport. H. F.

Potentilla argentea.—Shrewsbury road, Claughton Village, a single plant. F. M. W.

Rosa Sabini.—Small heath near Bebington Station. F. M. W. and H. F.

Rosa villosa.—Is a common plant in Cheshire.

Rosa tomentosa.—Near Mollington. H. F.

Œnothera biennis.—Near Leasowe Castle. F. M. W.

Myriophyllum alternifolium.—Pond near New Brighton. H. F.

Ceratophyllum demersum.—Plentiful in ditch at Bidston Marsh. F. M. W.

Bryonia dioica.—Hedge, Ditton Marsh. W. Hitchmough.

Cotyledon Umbilicus.—Plentiful and fine on walls about Noctorum Farm. F. M. W.

Cicuta virosa.—Abundant in a pond at Ellesmere. Mr. Bennett.

Ægopodium Podagraria.—Abundant in a small plantation opposite lodge to residence of W. Jackson, Esq., M. P., Claughton. F. M. W.

Œnanthe Lachenalii.—Ditches near Leasowe Lighthouse. F. M. W.

ŒNANTHE PHELLANDRIUM.—Lane from Hale road to Old Hut, in a pit on left hand side. F. M. W.

CONIUM MACULATUM.—Plentiful at Ellesmere Port. Mr. Bennett.

FEDIA DENTATA.—Field near Woodchurch, again near Ness, and in other places. F. M. W.

CARDUUS ACANTHOIDES.—Road side before coming into Hoylake.—H. F. and F. M. W.

CARDUUS MARIANUS.—Waste ground near warehouses, Birkenhead. H. F. (Outcast.)

CENTAUREA CALCITRAPA.—Near the railway crossing Birkenhead Docks, 1858 (at present there ?); probably, in this instance, a ballast plant.

CONVOLVULUS SOLDANELLA.—Shore below Dee Inn, West Kirby. F. P. Marrat and I. Byerley.

SYMPHYTUM OFFICINALE.—Plentiful at Ellesmere Port. Mr. Bennett.

MELAMPYRUM PRATENSE, var. MONTANUM.—Hills in the neighbourhood of Frodsham. Miss Johnson.

PEDICULARIS PALUSTRIS.—*White flowered* variety, moist ground below Flaybrick Hill. Very sparingly. F. M. W.

LIMOSELLA AQUATICA.—Margin of Raby mere. H. F.

OROBANCHE MINOR.—Speke, on clover. W. Hitchmough. Clover field, Litherland Moss. H. F.

ORIGANUM VULGARE.—Near Hightown Station. H. F. and F. M. W. (Outcast.)

SCUTELLARIA MINOR.—Ditch on Thurstaston Hill in direction of Irby Windmill. F. M. W. and H. F. Marshy piece of ground at commencement of Bidston Heath.

NEPETA CATARIA.—Near Mollington, plentiful. H. F.

LAMIUM MACULATUM.—Occurs in several localities, but always as an outcast.

Littorella lacustris.—Abundant on Frankby mere. H. F. and F. M. W.

Polygonum Bistorta.—Field by side of West Park road, Claughton. F. M. W.

Euphorbia Lathyris.—Corn field, Sankey Green. C. S. Gregson.

Gymnadenia conopsea.—Field by which the pathway from Hoylake to West Kirby passes. H. F. and F. M. W.

Convallaria majalis.—Fir plantation between Egremont and New Brighton. H. F.

Allium vineale.—Hale. C. S. Gregson.

Arum maculatum.—Prenton Wood. H. F. and F. P. Marrat; and about Noctorum and Woodchurch. F. M. W.

Acorus Calamus.—Plentiful at Ellesmere Port. Mr. Bennett.

Potamogeton oblongus.—Margin of a pit on Oxton Heath. F. M. W. (Will probably prove frequent.)

Eleocharis uniglumis.—Sevenpits, Aintree. H. F.

Poa rigida.—Plentiful on shore below Heswall.

Botrychium Lunaria.—Very fine in a field behind Mr. Curry's house, at Claughton Village, and occurs sparingly on a heathy piece of ground by side of Upton Road, a little past Claughton Village. F. M. W.

Pilularia globulifera.—Pit on Oxton Heath, above Noctorum Farm. F. M. W. and H. F.

Lycopodium inundatum.—Moist places, Oxton Heath, where the turf has been cut. F. M. W.

Lycopodium Selago.—Heswall Hill, (sparingly.) H. F. and F. M. W.

Dr. Collingwood also submitted the following list of rare plants and new habitats, discovered in his excursions

with his Botanical Class, during the summer session of 1860 :—

Ranunculus Lingua.—Raby.
Lepidium latifolium.—Crosby.
Malva moschata.- Raby.
Geranium sanguineum.—Caldy.
Helosciadium inundatum.—Wallasey Marsh.
Campanula latifolia.—Hale.
Gentiana Pneumonanthe.—Raby.
Convolvulus Soldanella.—New Brighton Sand-hills.
Veronica montana.—Ainsdale.
Pinguicula vulgaris.—Raby.
Parietaria officinalis.—Crosby.
Habenaria bifolia.—Simonswood Moss.
Ophrys apifera.—Crosby.
Colchicum autumnale.—
Lycopodium clavatum.—Storeton.
Lycopodium inundatum.—Hale.
Anacharis alsinastrum.—Rock Ferry.

Mr. F. P. Marrat submitted the following list of Mosses from new localities, several of which were gathered during the excursions of the Naturalists' Field Club :—

Gymnostomum tenue, Schrad.—(Slender beardless moss.) Wils. T. 7.

On the wall supporting the north bank of the railway between Huyton Gate and Huyton Quarry. F. P. M.

Desmatodon nervosus, Br. and Schrad.—(Thick-ribbed Desmatodon.) Wils. T. 20.

On a wall at West Kirby, fruit young in November. New to this district. F. P. M.

Hedwigia ciliata, Hed.—(Hoary branched beardless moss.) Wils. T. 6.

On the wall between Bromborough Village and the stile road leading to Eastham Ferry. The plant is now growing here, October, 1860.

Racomitrium aciculare, Brid.—(Dark mountain fringe moss.) Wils. T. 19.

On a dry wall between Hooton Station and Willaston, in

company with Hed. ciliata. A very strange locality for a water moss. New to this district. F. P. M.

ORTHOTRICHUM STRAMINEUM, Harnsch.—(Straw coloured bristle moss.) Wils. T. 45.

On trees near the stream between Bromborough Station and Raby, rare. New to this district. F. P. M.

ORTHOTRICHUM TENELLUM. Bruch.—(Slender-fruited bristle moss.) Wils. T. 45.

On a prostrate poplar near Hightown. F P. M.

ORTHOTRICHUM SPRUCEI, Mont.—(Spruce's bristle moss.) Wils. T. 45.

With O. stramineum as above.

POLYTRICHUM FORMOSUM, Hed.—(Buff-fruited hair moss.) Wils. T. 46.

Eastham Wood, June, in fine fruit. New to the district. F. P. M.

BRYUM NEODAMENSE, Itzigsohn.—(New thread moss.)

In a pond called the Bullrush Slack, Ainsdale. This is the moss named Bryum formosum by Wilson and Marrat, and is considered a water variety of Bryum pseudo-triquetrum by Dr. Schimper in his new synopsis. Such, however, I cannot regard it. In its cucullate and deflexed leaves it differs from every form of that moss, and also from the water variety of B. psuedo-triquetrum growing in a pond a short distance from this station.

BRYUM ULIGINOSUM, Br. and Sch.—(Bog thread moss.) Wils. T. 48.

On a wall near the bridge crossing Bromborough Pool. F.P. M. No notice of this species growing on walls has hitherto been recorded.

BRYUM LACUSTRE, Bland.—(Small round-fruited thread moss.) Wils. T. 48.

In some marshy ground in the brickfield behind Huyton Quarry, August 26th, 1860. F. P. M. This was the first time the moss had been gathered for nearly fifty years. On my next visit to this locality I found to my great dismay, the place as level as a turnpike road, and not more productive, having been filled with rubbish from Huyton Quarry. On the 30th of August, Mr. Wilson found it again

at Ainsdale, and on the 15th of September Mr. W. and myself gathered it in considerable plenty between Birkdale and Ainsdale. Its time of fruiting is therefore not May and June, but September and October.

BRYUM OBCONICUM, Harnsch.—(Obconical thread moss.) Wils. T. 49.

On the wall supporting the north bank of the railway between Huyton Gate and Huyton Quarry, August 26th. Very rare. F. P. M.

BARTRAMIA CALCAREA, Br. and Sch.—(Thick-necked apple moss.) Wils. T. 52.

In the Pinguicula bog at Raby. F. P. M. New to the district. Rare.

LEUCODON SCIUROIDES, Schwaegr.—(Squirrel-tail fork moss.)

On a tree near Bromborough Station. F. P. M.

HYPNUM GIGANTEUM, Schimp.—(Gigantic feather moss.) Schimper's Synopsis, page 642.

This is my variety of H. cordifolium mentioned in the list in 1855, and then regarded as a form of that moss. Recent investigation has proved it to be diœcious, hence the necessity for the new name.

HYPNUM STENOPHYLLUM, Wils. MSS.—(Slender-leaved thread moss.)

Dr. Schimper has erroneously placed this as a variety of H. fluitans. I formerly made the same mistake. It is diœcious, and a variety of H. exannulatum, of Br. and Sch., the H. aduncum of Wilson.

HEPATIC.

PETALOPHYLLUM RALFSII, Wils.—E. B. Sup. T. 2874.

Ainsdale. William Wilson, Esq.

LICHEN.

LECANORA CARNEO-LUTEA, Ach.

On a wall of Mr. Gladstone's, between Broad Green and Roby. New to the district. F. P. M.

The additions to the Fauna were postponed till the next meeting.

The following paper was then read—

ON THE BIRDS WHICH NEST IN THE DISTRICT.

(PART II.)

BY J. FITZHERBERT BROCKHOLES, ESQ.

IT will be remembered that the former portion of this paper (Proceedings, 1859-60, p. 115) treated of the land birds which nest in the district of Liverpool as far as the end of the Fringillidæ, following the classification used by Yarrell. To these must be added another species which I discovered last spring,* together with some further remarks concerning birds already mentioned. This additional matter will form a supplement at the end of the present paper, which is intended to notice the remainder.

The Starling *(Sturnus vulgaris)* deserves all patronage, as well for its social, interesting, and often confiding habits, as for its utility. It is blamed for stealing the eggs or small young of dovecote pigeons; but, I think, undeservedly—the mischief is more probably due to rats. The Starling's food consists mainly, if not entirely, of worms, grubs, &c., and the bird is, therefore, the farmer's friend. Flocks may be seen almost throughout the year frequenting grass lands in search of food, either alone or in company with rooks, lapwings, &c. There is nothing particular about the song, though, probably, most people like to hear it from their chimney top. The flight is peculiar, and consists of a series of long plunges, directed upwards, downwards, or sideways, but always tending to an onward course. It is maintained with greater rapidity and violence than that of almost any other bird. The nest, composed of hay or straw, lined with the softer portions,

* The bird referred to is the Garden-warbler (*Curruca hortensis*), which was first remarked by Dr. Collingwood in the spring of 1858, and is recorded in the "Proceedings" for 1858-59, p. 10.—ED.

is simple and unpretending. It is placed in a chimney, a spout, or dovecot, in a hole in a wall or tree, and sometimes in or about the nest of a rook, crow, or magpie, even though this be tenanted by its rightful occupants. The eggs, five in number, are pale blue.

A pair of Ravens *(Corvus corax)* built their nest at Hilbre two or three years ago, but were driven away before the young were hatched, by boys who threw stones at them. The nest, similar to that of a crow, was placed in a niche in the rock on the western side of the middle Island. Their eggs, also, resemble those of the crow, but are usually larger.

The Crow *(Corvus corone)* is resident; it occurs sparingly in the district, and nests occasionally in the more retired woods. This species is not gregarious, though sometimes many may meet in a favourite roosting place, or other spot where there is some attraction. The nest, composed of sticks covered with mud, and lined internally with fibres, is placed in a tree. There is seldom a second in the same wood, though occasionally, several may occur in one vicinity. In one remarkable instance, I saw three in the same tree. The eggs, four to six in number, are greenish gray, variously marked with dark gray, olive green, and dull black.

The resident Jackdaw *(Corvus monedula)* is sufficiently common, and is much more social than the two preceding species. It not only congregates with others of its kind, but is partial to the society of rooks and starlings. It is a lively, noisy bird, but the note is much more mellow and pleasing than that of its congeners. The nest, composed of sticks, lined with fibres, wool, &c., is placed in a church tower, ruin, or chimney; in a niche or hole in a rock, and sometimes in a rookery. The eggs, four or five in number, are greenish white, freckled or spotted with two or three shades of gray, olive brown, or dull black; but they vary considerably.

The Rook *(Corvus frugilegus)* is well known, but unfor-

ately little understood by farmers, who kill so many by
soning their seeds. Few birds are more useful to the
iculturist, and few do less harm. The system of poisoning
ds ought to be strongly discountenanced, especially as it
angers and sometimes destroys more than is intended.
tances, I believe, have occurred where pigs and other stock
e died through eating a poisoned carcase. The Rook, it is
l known, builds in societies, and constructs its nest of
ks, covered with mud, and lined internally with fibres. The
s, four to six, are green or greenish white, suffused, speckled,
tted or blotched with olive brown, or dull black. They
very variable.

The Magpie *(Pica caudata)* is sufficiently abundant
oughout the wooded parts of the district. Game preservers
troy it on account of its thievish, egg-loving propensities,
that it will be less frequent on preserved parts than on
ers. Though too frequently disliked and persecuted, this
y bird has considerable interest for the ornithologist, on
ount of its versatile habits, cunning and capabilities. It is
gregarious, though sometimes a family may be seen
ether. In early spring, it is not uncommon to find from
lve to thirty associated; but these do not remain long
ether, and have probably met for the purpose of pairing.
the summer months, magpies use notes which are very
ferent from their well-known ordinary harsh one. These
produced in a subdued key, often mellow and pleasing, and
netimes puzzle the experienced to know their author. The
ned nest, composed of sticks, covered with mud, and lined
ernally with fibres, is placed at various elevations in a tree
bush. The birds frequently build it in a spot difficult of
ess; but, strangely enough, they constantly choose the
st exposed situations for their earliest nests. Those built
March, or early in April, are placed in isolated trees or
shes, or in narrow plantations where they are exposed to all

weathers, and to the view of everything for a long distance. When the foliage is expanding, the later nests are built in larger woods, and the hand can scarcely be inserted without receiving scratches. The eggs, six to eight in number, are very variable. Typical ones are greenish gray, freckled or spotted all over with two or three darker shades, and olive brown.

The Jay *(Garrulus glandarius)* is resident in most large woods. In common with the crow and magpie, it is persecuted for its thievish, egg-sucking propensities, though extreme wariness, and more retired habits, enable it to maintain existence where others fail. Scarcely is an enemy within sight when the harsh note of the Jay gives the alarm, and all the tribe fly off. In the summer months, when there is abundant shelter, other notes are used. These are varied, subdued, and sometimes mellow—so much so, that on one occasion I heard them blended and prolonged into a pleasant warble. In addition to its own ordinary notes, the Jay will imitate those of other birds, sometimes sufficiently well to deceive. I have heard it produce the quail's note in a rather rough, loud key; and on several occasions I have been puzzled to detect its imitation of that of the crow. The nest, composed of sticks and roots, lined with fibres, is placed at various elevations in a tree or bush. The eggs are grayish brown, freckled or mottled all over with a darker shade; they are usually five in number.

The greater spotted Woodpecker *(Picus major)* is an occasional visitor. A pair nested in Bromborough Wood last spring. The hole in which the young were reared was freshly made in a dead part of the oak immediately below where a brood of goat-moth larvæ *(Cossus ligniperda)* had been. It passed horizontally through the bole for three or four inches, and then descended in a rather oblique direction for about a foot. The entrance was only large enough to admit the birds singly, but the hole was rather larger towards the bottom.

he chippings were not conveyed away, but remained under-eath just as they had happened to fall. The entrance to the ole was at an elevation of about twelve feet. The eggs are lossy white. The female was bold and pugnacious while on ie nest; on placing a stick in the entrance to prevent egress, he scrambled up, bit it angrily, and in so doing produced a nawing sound somewhat similar to that made by mice. The iale, on the contrary, quietly awaited an opportunity to scape. The birds occasionally resorted to the ground, pro-ably in search of insects.

The common Creeper (*Certhia familiaris*) resides in the istrict, though in smaller numbers than formerly. It is highly iteresting to watch these birds in search of insects; and othing can exceed their graceful movements whilst running n the trees. No position seems amiss to them, and they alk with equal ease up, down, or round a tree or branch, or ang with the head downward for an indefinite length of time. hould they stop, whilst ascending, to pick an insect from a revice, or from under the bark, they place the tail against the ole, as do the woodpeckers, and use it as a means of support. he noise produced by pecking against the tree is sometimes oud, considering the size of the bird, and may be heard at a oderate distance. Whilst looking for insects, the Creeper ill occasionally dislodge pieces of bark of the size of large uts, which shows considerable strength. The nest is placed ehind loose bark, detached ivy, or in a hole in a tree. I have nown one in a hole in a wall, and another on the part of a ee trunk where a large branch had been abruptly broken way. I have not seen one for some time, and do not remember ie materials used. The eggs are white, spotted with reddish rown.

The Wren (*Troglodytes vulgaris*) is a well-known resident, nd one which invariably sings throughout the year. Though oud, the song is lively, clear, and pleasing. In habits, the

Wren is restless and active, bold and fearless, frequenting woods, hedge-rows, isolated bushes, banks, and open commons, especially those parts where there is shelter amongst rough herbage. It creeps quickly and mouse-like through bushes, hollow banks, and over the surface of the ground, and indulges frequently in short flights. In winter, this bird, though so small, feeds extensively on snails, extracting them from the shells in an ingenious manner. When a snail is found, it is conveyed to a selected stone, and tapped upon until the shell breaks, or the animal otherwise becomes detached. It is then easily taken out and devoured. The same stone will often be resorted to for a long time, so that a considerable number of shells will frequently be accumulated. These remains may often be noticed, and as often, perhaps, have puzzled the beholder. In winter, also, Wrens collect in numbers in warm favourite roosting places. At dusk, the observer, by remaining quiet, may see them coming singly from all directions to a favourite hay-stack. On arrival, they locate themselves in holes previously made round the sides by their own species, or other small birds. By going after dark, the observer may sometimes take them by the dozen in a handful from one hole. Old or unfinished nests are often chosen as dormitories, and sometimes unlined ones are built expressly for the purpose. The sites selected for these, and those required as cradles for their young, are as varied as the haunts: low branches of trees, sprays growing from the boles, bare roots of trees under hollow banks, holes in walls, banks or hay-stacks are the most common. I have known the nest at an elevation of about fifteen feet, but such instances are rare. Great skill is shown in adapting it to circumstances, and the materials used in the construction differ according to the situation. Composed generally of that which abounds in the neighbourhood, it resembles more or less closely the objects which are near. If in a bank, for instance, it is composed chiefly of moss; when

in a wall or stack, hay is the principal material; and dead leaves are often the main component of those in trees and bushes. It is domed, and has the entrance on one side. The eggs, which are white, dotted or spotted with reddish brown, are numerous, and commonly seven in number.

The Cuckoo (*Cuculus canorus*). This favourite and common summer visitor, although apparently without affection for its offspring, is strongly attached to its mate. Wherever the one bird is, the other is seldom far off. It is well known that the eggs are placed in the nests of other birds, and that the parental duties devolve upon these. The nests of the various insectivorous species, as well as those of larks, buntings, and finches, are chosen, though preference seems to be given in this district to the nests of the meadow-pipit, and sky-lark. Strangely enough, I have never yet seen the egg of a Cuckoo in the nest of the hedge-sparrow. It is, probably, a rare occurrence for the Cuckoo to select a sparrow's nest when built in a wall, yet I have known such an instance. When a boy, I saw a Cuckoo enter a moderately large oval hole in the wall of a hay-loft —one of those ordinarily left in farm buildings to admit air— and which contained a sparrow's nest The purpose of the stranger's visit occurred to me, and on climbing up soon afterwards, I found a Cuckoo's egg amongst the legitimate ones. Cuckoo's eggs are small, compared with the size of the bird, and are very variable. They are pale, or dark gray, often reddish, brown, or olive, dotted, spotted, and sometimes blotched with darker shades. Occasionally, two are found in the same nest, but more frequently only one. It is highly probable that the Cuckoo deposits several.

The Kingfisher (*Alcedo ispida*) is resident, though in decreasing numbers, owing, no doubt, to the too frequent desire of obtaining so beautiful a bird. It is an interesting sight to watch it catch its prey. Perched, motionless, on a projecting stone, or overhanging bank or branch, it suddenly plunges at

a passing fish, and instantly reappears; or stopping its rapid, onward flight, it hovers for a moment over the stream, and swiftly darts into the water, seldom missing the fish, though rarely seen to swallow it. The impetus with which the plunges are made must be very great, as the bird is far too buoyant to sink in water without the application of considerable force. The nest is composed of the indigestible portions of fish, and is placed some distance within a hole in a dry bank. The eggs are glossy white.

The Swallow (*Hirundo rustica*), also an annual summer visitor, appears in greater or less numbers, on or about the 23rd of April. The nest, composed of mud, mixed with hay, and lined internally with feathers, is placed on a ledge in a chimney, or against a beam in a farm building or outhouse, and sometimes against a rafter supporting a bridge. It is never domed; neither is it ever attached by the rim to any ceiling, &c. An unusual form of nest, built in a tree at Maghull, has come within my notice. It was composed of the ordinary materials, but formed, like a chaffinch's, amongst twigs: such instances are rare. The eggs, five in number, are white, dotted, or spotted with reddish brown.

The Martin (*Hirundo urbica*) arrives annually, in considerable numbers, to spend the summer with us. The nest, composed of mud, mixed with hay, and lined internally with feathers, is placed against a beam in an outhouse, or wall, or under the eaves of a building, or bridge. It is almost always domed, or attached by the rim to a ceiling, or the lower part of another nest, &c. The Martin often builds in societies. The eggs are white, and five form the complement.

The Sand-Martin (*Hirundo riparia*) generally arrives with the swallow in each year, and is, perhaps, the most abundant hirundine which visits the district. It is a social bird, and colonies of varying extent take possession of suitable banks in quarry sides, &c , for the purposes of nidification. Each

pair makes a separate hole, which is sometimes three or four feet in length, and serves, unless disturbed, for several seasons. The nest, composed of hay, lined with feathers, is built in an enlargement, at a distance of half a yard or more from the entrance. The eggs, five in number, are white.

Sometimes large flights of Swallows, Martins, and Sand-Martins arrive in company; and at others, any two of the species will come together. The higher end of Wallasey Pool, on the side of Bidston Marsh, is a favourite resort on their first arrival; and before they disperse, they may sometimes be seen so tired as scarcely to be able to fly. Previous to their departure, they congregate in similar flocks in the same neighbourhood, and roost amongst the adjacent reeds.

The Swift (*Cypselus apus*), an annual summer visitor, is one of the last to arrive, and the latest to commence nidification. Nests which I have known have been appropriated from the sparrow, and have contained young in the middle of July. They are often difficult to reach, owing to their being placed within serpentine holes in walls and Church towers. The eggs are white, and long in proportion to their breadth.

The Nightjar (*Caprimulgus Europæus*) annually visits the firwoods on the Cheshire side to spend the summer. Formerly, the species was much more abundant in the vicinity of Birkenhead than at present; but the numbers which nest there are yearly decreasing, owing to the increase of persons who shoot them. It would be a pity were so useful, interesting, and harmless a bird to be annihilated in the district. Their graceful evolutions performed in the evening twilight, whilst hawking for the insects which form their sole food, are well worth watching; and the twice-repeated sharp note used when on the wing is sometimes rather startling. What may be termed the song is uttered from a perch, and resembles the croaking of natterjack toads. The eggs, two in number, are white, spotted, blotched, or marbled over with black, leaden gray, or various

shades of brown. They are laid upon the bare ground, or on an accumulation of decaying vegetable matter. No nest is formed.

The wary, shy, and retiring Ring Dove (*Columba palumbus*) is an abundant resident throughout the wooded parts of the district. Its meagre, almost flat nest, composed of sticks and fibres, is placed at various elevations in a tree or bush. I have known of one built on a large accumulation of dead leaves, &c., which remained in a tree. It is strange that the magpies, which had a nest in the adjoining fir, left it undisturbed. The eggs, two in number, are white; three or four broods are reared in the year.

The Stock Dove (*Columba œnas*) frequents the haunts of the preceding bird, but is less plentiful. It breeds here, and is probably resident. The nest, similar to the one last described, is sometimes built in a spruce or other evergreen fir, and more frequently in ivy. The eggs, two in number, are white. The feathers of these two species are very slightly attached to the skin, and consequently come off easily. Both birds will fly long distances to salt, vetches, or other favourite delicacy.

A pair of Rock Doves (*Columba livia*) frequented the high portion of the river's bank between Eastham Ferry and Hooton during the spring, three or four years ago, and no doubt nested there.

The Turtle Dove (*Columba turtur*) occasionally visits the district, and, being a summer migrant, may sometimes nest here.

The Pheasant (*Phasianus colchicus*) scarcely needs a comment. During incubation the female sits very closely—so much so that even the wild birds will not stir though an intruder almost steps upon them. The nest, composed of leaves, dry grass, &c., is frequently made amongst dead herbage, which, accords well with the sober plumage of the hen, and helps to conceal her from her enemies. A close and

practised observer will sometimes walk over without seeing her. The hen will occasionally cover her eggs with leaves, &c., on leaving her nest. The pheasant is polygamous; the eggs, nine to fifteen in number, are brown or greenish brown.

I am informed that there are Red Grouse (*Lagopus scoticus*) on Simonswood Moss, and that the bird is constantly within the ten miles' circle. The eggs are brownish buff or reddish gray, variously spotted with several shades of rich deep brown.

The Partridge (*Perdix cinerea*) also is a favourite, and well known resident. The slight collection of dead leaves or dry grass which forms the nest is placed any where in a field, hedge-row, or margin of a thicket. The eggs, nine to twenty, are brown. I once knew a nest containing thirty-nine, but these were probably laid by two birds.

The Quail (*Coturnix vulgaris*) is an annual visitor, frequenting the neighbourhood of Birkenhead in some numbers. Owing to its retiring habits, it is seldom seen, and consequently much less known than either of the preceding. The abundant shelter in its favourite haunts in meadows and cornfields conceals it until the autumnal migration leads the majority to winter in more genial climes. Owing, probably, to the young being hatched, for the most part, before hay-time, the nests are seldom found. The eggs are buff, variously spotted and blotched with rich brown.

The resident Ringed Plover (*Charadrius hiaticula*) breeds sparingly round the shores, but forms no nest. A shingly place at the junction of the land with the beach is a favourite situation for the purposes of incubation. The eggs, four in number, are placed *quatrefoil* in a slight depression, with the small ends towards the centre. They are large in proportion to the size of the bird, and unless arranged in the most economical manner with regard to space, the birds could not cover them. They are buff, spotted with black, and so closely resemble the surrounding ground that they are found with

difficulty. All the wading and swimming birds are nocturnal as well as diurnal, and all are more or less wary. Their notes at night are often very different from those used by day.

The Lapwing (*Vanellus cristatus*) frequents the more retired and wilder portions of the district throughout the year. The poorest lands covered with a scanty vegetation are the most favoured in the breeding season; fallow fields also and spots where, through some local or other cause, the crop has failed, are used by a few pairs. It seems perfectly immaterial whether a nest is constructed or not; but as far as my own observations go, the birds always scratch a depression for the purpose. The eggs are quite as frequently laid upon the bare ground in this little hollow, as on a more or less well formed lining of dead grass. They are buff or brown, spotted with black; and being four in number, are placed *quatrefoil*; they are variable, and difficult to find. A considerable amount of damp does not seem to injure them, as I have often seen them in very wet nests without ever finding bad ones. There is a charm in the wild lands frequented by the Lapwing at this season which is not found elsewhere; the calm beauty of a mild, sunny, spring morning is enhanced by the quiet solitude, the wild but pleasant notes of the birds, their varied and graceful evolutions, and their stratagems to decoy an intruder from the neighbourhood of their nests or young. The latter run almost as soon as hatched, and have the instinct from the first to squat cunningly on gravel or amongst vegetation on the approach of danger. When thus concealed it is very difficult to detect them. The parents are ever near to warn, disperse, or call them together, by means of various notes and actions. At a late season they associate in flocks, resort to favourite feeding grounds on the land or shores, and continue thus till the return of spring.

I have good authority for stating that the Oyster-catcher (*Hæmatopus ostralegus*) has been known to breed near Hoy-

lake. The eggs are pale brown, streaked and spotted with two or three shades of darker brown, and dull black.

The Heron (*Ardea cinerea*) may be seen in the district throughout the year, and most probably still continues to nest here, at least occasionally. There was formerly an established Heronry at Hooton, which, I am informed no longer exists; the eggs are green. Though it is extremely difficult to surprise so wary a bird, an observer may, by approaching under shelter of whatever is available, have opportunities of watching it feed. During the winter season more than two are seldom seen inland together, but there are favourite resorts on the shores where sometimes numbers congregate to feed. One of these places is near Flint, on the Welsh side of the Dee, where I have seen from thirty to forty in comparatively close proximity. There also may often be seen several rows, consisting of from two to ten individuals, arranged at moderate intervals, with single birds interspersed. The Herons thus forming a row will be at distances of a few yards apart, and in an almost straight line. The effect produced by their standing motionless in the margin of the water, waiting patiently for passing fish, is striking, especially should there be sandpipers, gulls, and other wild fowl all round. I am told that Herons congregate in a similar manner on the shore near Ellesmere Port. When these birds rise of their own accord without being disturbed, they sometimes describe a spire of gradually enlarging circles, until the desired elevation is attained. The slow, heavy, measured flight is then continued in an undeviating line for a great distance. Two birds rising with such a spire at the same time and place have a curious appearance, and give the idea of a double corkscrew. I have several times seen the leader of two flying Herons change its course on a call note being given by the second.

The common Sandpiper (*Totanus hypoleucos*) formerly visited the neighbourhood of Birkenhead in considerable

numbers, but these have decreased until one or two pairs are all that now spend the summer there; the nest, generally near a pond or stream side, is occasionally some distance from water. The eggs are buff, dotted or spotted with reddish brown and leaden gray.

Three or four pairs of Woodcocks (*Scolopax rusticola*) frequented woods near Birkenhead last spring, and no doubt nested there. The eggs are rounder than those of other birds belonging to the tribe, and are buff, spotted with two or three shades of reddish brown. Others, as well as myself, have previously seen Woodcocks at intervals during the summer months, so that there is no doubt they at least occasionally breed here.

The Snipe (*Scolopax gallinago*) is resident, and may be met with singly or in pairs throughout the spring and summer. I have frequently seen them near Brimstage, where I am satisfied they nested. They may also be found in other localities at the same season. The eggs are light brown or greenish brown, spotted or blotched with several darker shades; curious varieties occur.

A few pairs of the Dunlin (*Tringa variabilis*) remain in the district throughout the spring and summer, and unquestionably breed here. The eggs are greenish gray or pale buff, variously marked with rich reddish brown. A person strolling on the shore in winter cannot fail to be struck with the quick, elegant action of a flock of Purres flitting past him in small parties over the margin of the water. A white cloud of countless numbers is seen at a distance seaward, but suddenly it vanishes; presently, a broad, brown centre connects a white end with a black one; then a white centre couples two dark extremities, and they all vanish for a time. Now a dark mass of objects is seen in rapid motion, again and again to disappear, and as often to reappear under some newly varying aspect, until at length all alight on the sandy banks. They are unsettled,

or something disturbs them,—they rise again, perform more of these interesting evolutions, and finally disperse in small flocks. These varied appearances are produced according to the part of each bird seen at the time. The backs show brown, and the bellies white, and more or less of either would give corresponding shades; and when the flock has become invisible an extremity of each bird with the edges of the wings are turned towards the beholder. When pairing in spring the male Purres are very jealous and pugnacious, and are very amusing at that season.

The Landrail (*Crex pratensis*) annually visits the district in greater or less plenty to spend the summer. Its retiring habits cause it to remain concealed in favourite meadows or cornfields, consequently it is seldom seen. The note, however, is well known. The nest, composed of dead grass, is placed on the ground. The eggs, six to nine in number, are pale buff or whitish, spotted or blotched with reddish brown, and sometimes faded lilac.

The Water Rail (*Rallus aquaticus*) has been observed in the district throughout the year, so there is no doubt it breeds here. The eggs are pale buff, spotted with reddish brown and dull lilac.

The Moor-hen (*Gallinula chloropus*), a well known and abundant resident, is less shy than the preceding. Unlike many allied species, it frequently perches in trees and bushes, and where undisturbed, may be seen abroad at all hours. The Moor-hen frequents most sedgy ponds and waters, until frost compels it to seek food and shelter by the sides of streams. Although not webfooted, it takes the water freely and swims well. The nest, composed of various aquatic plants lined with the soft, dry portions, is a high, rude, rather bulky structure. It is placed on the water amongst the branches of a bush or rank vegetation in the shallower places, and is fastened firmly to whatever is near it. I have seen one on a

spreading branch immediately overhanging the water of a mill-pool. The eggs, six to eight in number, are buff, spotted with various shades of reddish brown. I have heard of thirteen young ones following one old bird, and have myself seen ten eggs in the same nest. A curious circumstance with regard to these latter was, that six were considerably incubated, whilst four were only slightly so. The question naturally arises, were all laid by one bird? If they were, it is a singular instance of irregularity. Domestic fowl, I believe, occasionally lay one egg or more at intervals whilst sitting, but that a wild Moor-hen should lay four in succession seems strange. If the four were laid by a second bird, great watchfulness on her part, and perhaps regularity on the part of both, the one in leaving the nest and the other in laying, are indicated. The second bird may have been the stronger, and may have pushed the other off the nest when she wanted possession; or perhaps a friendship existed between them. The young leave the nest soon after exclusion from the eggs, and I have seen one of the first-born scrambling up the side before the late ones were hatched.

The Coot (*Fulica atra*) sometimes visits the district, and may occasionally nest on retired pools within the ten miles' circuit. The bird is resident and breeds regularly in different localities within easy distance. The eggs are buff, dotted and spotted with dull black.

The Shelldrake (*Tadorna vulpanser*) occasionally nests at Hilbre. The nest is placed in a rabbit burrow, often far down, but in other respects, I believe, is similar to that of ducks. The eggs are white, tinged with a shade of greenish buff.

The Wild Duck (*Anas boschas*) is probably resident in most years. It sometimes nests at Brimstage and the adjoining part of Storeton. The nest is generally on land, and not necessarily near water. It is composed of grasses, &c., carelessly arranged, and during incubation feathers and down are

accumulated to a great extent about it. The eggs are greenish buff.

The Teal (*Anas crecca*) occasionally breeds here. In the spring of 1856 I received eighteen eggs from the neighbourhood of Leasowe. They were taken from three different nests, but were most probably laid by one bird. The first nest was composed of a great quantity of material, well lined with feathers and down, whilst the second and third were of less material, and no feathers. All were amongst grass, near reedy ditches between Leasowe and Wallasey. The first contained the complement of nine eggs, the other two, five and four respectively; all were of a pale cream-colour.

My authority for the Oyster-catcher also told me that either the common Tern (*Sterna hirundo*) or the lesser Tern (*Sterna minuta*) had been known to breed at Hoylake. He was not certain which it was, but either one or both may occasionally nest there, or in the neigbourhood of Crosby. I have seen the common Tern apparently located beyond Crosby, and the lesser Tern is sometimes common between the Point of Air and Rhyl. The eggs of the former are very variable. They are pale brown, spotted and blotched with dull dark gray, and several shades of deep brown. Those of the latter are light brown, spotted with dull dark gray, and various shades of deep brown.

I have now noticed all the birds which I have ascertained to nest here, except the Garden Warbler, which will be mentioned in the supplement to the first part of this paper. I have also referred to several which there is good reason to believe do so. The total number, ninety-six, is probably a fair amount for so small an area in the British Isles. Should the doubtful ones, not more than eight, be discarded from consideration, the list, I think, would still be a good one. A few localities are richer in wild fowl, but I doubt whether any similar area in Britain produces a total of more than about

one hundred nesting species. I have not seen any similar lists, so that I have not been able to make a comparison. Continued research may detect not only the doubtful birds already mentioned, but a few other occasional, if not permanent nesters. It would not be difficult to point out a few likely birds.

Differences of seasons materially affect birds at the nesting time. Late springs, with settled fine weather afterwards, are good; whilst early ones, with late frosts, are bad. Very wet springs are equally injurious to land birds, and the last season being one of this description, was marked with detrimental results. Many early nests of eggs on the ground were wholly or partially destroyed, whilst many of those in bushes suffered. I saw several wrens' nests in bushes become mouldy before they were finished.

Supplement to the First Part.

I have ascertained that the pair of Kestrels mentioned as frequenting a large rookery, did not occupy a rook's nest, but that they had their own on the top of an artificial ruin in the midst of the rookery.

The Sparrow-hawk sometimes lays all her eggs on consecutive days, and at others, two or three in that manner, and the rest at longer intervals. Incubation lasts a calendar month, and the young ones remain in the nest for about another month, so that probably three calendar months expire from the commencement of nidification to the time the offspring are finally left to shift for themselves. The young are born blind, but open their eyes to the full extent within a week. Being covered with a white down, they are pretty objects from the first. A nest containing five which I was watching last spring gave me some opportunities for observation. Unfortu-

nately, the young ones perished prematurely on the ground underneath, apparently through being frightened by boys who found them. On visiting the nest on probably the second day after the young had scrambled out, I found a store of twenty-three small birds besides portions of several others. Some were decapitated, others partially so, and all were plucked; the majority were perfectly fresh. They comprised thirteen sparrows, one greenfinch, one yellow bunting, one black-headed bunting, one cole, or marsh-tit, four young robins, and two which I could not identify. These, probably less than a two days' store, will give an idea of the havoc committed amongst small birds by the Sparrow-hawk. Even allowing an average of two per day to each, the number devoured by one individual would be seven hundred and thirty in a year. The male bird takes part in incubation.

On examining a considerable number of castings of the Barn Owl during last summer I discovered the skull of a sparrow, and one of some kind of thrush. This species, therefore, evidently preys occasionally on small birds, though far less frequently than the long-eared owl.

The Red-backed Shrike has again visited the district during the present year, and reared young at Rainhill.

During last spring, I found a second instance of a thrush's nest in the cavity of an old magpie's. Whilst in Wales last May I saw so many on the ground, in woods, that they almost ceased to be remarkable in that situation.

From accounts received from boys, a pair of Ring Ouzels visited the neighbourhood of New Brighton this year, and frequented the ground called the Warren through most of the spring. Nests of the Whinchat, built on the ground like those of larks, are not uncommon. I saw several such last spring, but none were at any great distance from a bush.

A pair of Garden Warblers (*Curruca hortensis*) visited the neighbourhood of Prenton Mount last Spring, but through

going from home at the time I did not see the nest. During last May I saw some nests of the Blackcap Warbler which were built amongst thick nettles. They were so like the ordinary nest of the whitethroat, that prior to their containing eggs, I was inclined to attribute them to that species. Judging from the nests alone, therefore, it is often impossible to decide to which bird they belong. I also found a standard nest of the Blackcap suspended in a bush of honey-suckle. Several sprays of the bush were woven into the rim, which was rendered firmer than ordinary by the interweaving of bits of wool with the rest of the material. There was no other support whatever. A second similar nest was suspended from the spreading branch of a tree, at an elevation of seven or eight feet.

The Wood Warbler's nest is domed. The dome is so slightly constructed, and so very slightly attached to the lower part, especially near the entrance, that it is very easily displaced. The nest, therefore, after being many times visited by the birds, or otherwise disturbed, is apt to have the appearance of being only half domed, as previously described. Six or eight nests found last spring, and examined minutely, bear out this view. All were constructed of coarse grass, lined with the softer portions, and a few straggling hairs. One example, similar to the rest in other respects, was partially lined at the bottom with five or six feathers. All were in depressions scratched in the ground by the birds; all were likewise on slopes in woods, and nearly, if not quite buried by fallen leaves and dead bracken. The nest cannot be seen, and the best way to find it is to flush the old one off, or watch her down to it. On several occasions visiting one containing young, the old bird hobbled down the bank for several yards, as if lame. It appears to be the habit of the species to do this, as I saw other individuals do the same. The complement of eggs is five or six.

The nest of the Chiff-chaff is also domed. The remarks just made about the dome of the Wood-wren's nest apply equally to this. In other respects, the nest is as formerly described; but in addition to being on or near the ground, it is not unfrequently placed in thick furze, prickly box, or other similar bush, at an elevation of sometimes as much as a yard. The site is variously chosen in a wood, and not necessarily near the margin. The complement of eggs is five or six. The Chiff-chaff will sometimes remain so closely on her nest that a person may almost walk over it without causing her to fly off.

Last winter was apparently a disastrous one for the Golden-crested Wren. During the subsequent spring there were very few in the Cheshire firwoods, where they generally abound throughout the year.

The Marsh Tit is certainly resident, and breeds here. I found a nest last spring containing callow young. It was built in a wall which bounded a wood.

Two nests of the common Bunting which came under my notice last season, were built in depressions scratched by the birds in the ground, amongst thick star-grass on the Sandhills. Both were constructed of grass, principally stalks, lined with fine fibres and a few hairs. Two others, found by a friend, were described to me as similar to these in every respect.

I also saw three nests of the Yellow bunting built in hollows scratched in the ground by the birds. These situations were evidently from choice, and not necessity, as there were plenty of young trees and bushes all round.

Two or three nests of the Chaffinch, seen during the past season, were profusely lined with a mixture of feathers and the standard hair.

Nests of the Lesser Redpole occur at various elevations in trees, as well as in the situations previously mentioned.

At the conclusion of the paper, the PRESIDENT remarked that he had listened to it with great attention, and complimented Mr. Brockholes upon the interest which he had thrown around the subject. He made some observations upon several of the topics which had been touched upon, corroborating the writer, and further illustrating the subject.

Dr. COLLINGWOOD bore testimony to the usefulness of the paper, which was full of original information, not derived from books, but the result of long, and patient, and watchful communion with Nature. In reply to a question raised by Mr. Higginson as to whether it was true that the Swallows had left this country a month earlier than usual on account of the inclement weather, he remarked that he scarcely believed it probable, or borne out by experience, that they should antedate their departure by so long a period. Birds seldom were influenced by the weather to so great an extent in their migrations; and the fact of the Swifts having remained their full time would seem to militate against it.

After some further discussion, the subject dropped.

EXTRAORDINARY MEETING.

After the business of the Ordinary Meeting, an Extraordinary Meeting was held, for the purpose of confirming the proceedings of the last meeting in reference to the election of Mr. William Brown as a corresponding member of the Society. The resolutions of the last meeting having been read, a ballot was again taken, and Mr. William Brown was declared duly elected a Corresponding Member. *

* Mr. William Brown having been elected an Honorary or Corresponding Member by each of the five learned societies of the town, the occasion of the opening of the New Free Public Library and Museum, October 18th, 1860, was considered a fitting time to present him with a joint Address, which was accordingly done at the Town Hall on the morning of the ceremony, in the presence of the Mayor (T. D. Anderson, Esq.), the Joint Councils, and numerous corporate, and other officials.

The address was read by Mr. J. Abraham, Hon. Sec. to the Joint Councils, and was handed to Mr. Brown by the Rev. H. H. Higgins, President of the Literary and Philosophical Society, who accompanied the presentation with suitable remarks. It was as follows :—

"To William Brown, Esq., of Richmond Hill, Liverpool.

Sir,

When you intimated your intention to present to the public a building for the Free Public Library and Museum of this town, and subsequently, when the foundation stone was about to be laid, several of the local learned Societies expressed to you their gratitude and good wishes.

You have since become entitled to their more especial acknowledgements. Within the present year you have given another proof of the warm interest which you feel in the progress of science, by providing an additional and spacious hall for the purpose of exhibiting objects of interest illustrative of the useful arts, and you have honoured our five Societies by requesting their advice and co-operation in its management.

To render this they consider their duty and their privilege: and as a means of expressing their entire and hearty appreciation of your munificence and courtesy, each of those Societies has had the pleasure of enrolling you in that class of its members which by its laws and constitution is most honourable, and they have jointly entrusted to us the agreeable duty of making to you this public and official intimation of the fact."

This Address, beautifully engrossed and illuminated upon vellum, was signed by the Presidents and Secretaries of the five Societies, in Alphabetical order, as follows :—

The Architectural and Archæological Society.
The Chemists' Association.
The Historic Society of Lancashire and Cheshire.
The Literary and Philosophical Society.
The Polytechnic Society.

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SECOND ORDINARY MEETING.

Royal Institution, October 29th, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The following Gentlemen were ballotted for, and elected Members of the Society :—

Rev. W. Banister, B.A.,

David Walker, M.D., F.R.G.S.,

(late Surgeon to the "Fox," Arctic exploring vessel,)

and Mr. Frederick Kirby.

The President announced that he intended arranging a series of working botanical excursions, in connexion with the Naturalists' Field Club, on Saturday afternoons, when the weather was favourable. A beginning was made on the previous Saturday, when a dozen ladies and gentlemen had accompanied him to Rock Ferry.

Dr. Collingwood, being called upon for the additions made to the local Fauna during the past year, said, that although much had been learnt, the results obtained were rather of a negative than of a positive character. He had been requested by the British Association, at its last meeting at Oxford, to dredge in the rivers Mersey and Dee, for the purpose of perfecting, as far as possible, our knowledge of those rivers; and with that view he had made three or four excursions during the summer on both rivers. He had not, however, to announce a large addition to the number of specific forms found in them, but had accumulated much information with

regard to the distribution and numbers of certain species. Among other results, he had satisfied himself that the common *Doris aspera* has not yet been found on these shores, while, on the other hand, its allied species, *D. proxima*, though not hitherto found elsewhere, is here everywhere common. It was this group of naked-gilled Mollusca which had perhaps been most studied; and two species had been added to the list, namely, *Eolis exigua*, which he had found at Egremont, and *E. olivacea*, brought by Dr. Edwards from Hilbre Island on the occasion of the Field Naturalists' excursion there; on which occasion, also, a new compound Ascidian, *Clavellina lepadiformis*, had rewarded the search. *Pilumnus hirtellus*, a species of crab, he had found upon the Egremont shore; and it had since been met with by Mr. Moore at Hilbre. Among the fresh-water Polyzoa some discoveries had also been made, viz., *Lophopus crystallinus*, found by Dr. Edwards in a ditch at Oxton; and *Plumatella repens*, brought by Mr. Moore from Raby. The small number of absolute additions made to the Fauna from year to year he regarded as a strong proof of the excellence and accuracy of the Fauna list prepared by Mr. Byerley, and published by the Society in 1854.

Dr. WALKER exhibited the egg of the little Auk (Alca alle) taken by himself in latitude 76½° N. Also a specimen of Anorthite, a mineral new to the British isles, and consisting of silica, alumina and lime, with traces of magnesia and oxide of iron. It was from Ireland.

Mr. DUCKWORTH exhibited a bow and arrows of the Veddahs of Ceylon.

Dr. COLLINGWOOD read a letter he had received from Professor Krauss, Director of the Zoological Department of the Royal Museum at Stuttgart, requesting him, if possible, to cause some marine Invertebrata from the British seas to be sent to the latter in exchange for other objects. Dr. Collingwood referred the subject to the keepers of the Free Public and

Royal Institution Museums, and pointed out a means by which they might possibly be preserved sufficiently for scientific purposes.

A paper was then read, of which the following is an abstract:—

ON DARWIN'S THEORY OF THE "ORIGIN OF SPECIES."

By the Rev. H. H. HIGGINS, M.A., President.

Mr. Higgins, in his introductory remarks, stated that it had been his intention to submit to the society an original paper on Mr. Darwin's book; but on reflecting that such a course would lead only to the addition of another review to the numbers which had already appeared, treating the subject more fully and more ably than he himself could hope to do, he had resolved to found his observations on the criticisms contained in the various serials in which Mr. Darwin's work had been reviewed. Some of the best of these he had not yet had time to examine; his remarks would, therefore, necessarily be very incomplete.

He considered the paper by M. Agassiz, inserted in the *Annals and Magazine of Natural History*, to be quite unworthy of so distinguished a naturalist. Having entered at some length into his reasons for holding this opinion, he said:—A singular argument is used by M. Agassiz to show that affinities between animals are not evidences of genealogical relationship. Similarity, he argues, between adult animals, is but an agreement in a single stage, and, if agreement in a single stage be sufficient to prove genealogical relationship, then, since the embryos of very distinct animals are much alike, there must be close relationship between these very distinct animals; a

reductio ad absurdum. M. Agassiz thus writes:—" A young snake resembles a young turtle or a young bird more than any two species of snakes resemble one another, and yet they go on reproducing their kinds, and nothing but their kinds; so that no degree of affinity, however close, can in the present state of our science, be urged as exhibiting any evidence of community of descent." A child might reply, if a young snake is more like a young bird than one old snake is like another, a young snake is not so like a young bird as it is to another young snake; so affinity, after all, is right in its indications. But this would be to concede to M. Agassiz far too much. Does an embryo snake resemble an embryo bird more than two kinds of snakes resemble each other? Differences of embryos must surely be compared amongst themselves, and not with the distinctions subsisting between adults.

M. Agassiz suggests:—" Would the supporters of the fanciful theories, lately propounded, only extend their studies a little beyond the range of domesticated animals; would they investigate the alternate generation of the Acalephs, the extraordinary modes of development of the Helminth, the reproduction of the Salpæ, &c., they would soon learn that there are in the world far more astonishing phenomena, strictly circumscribed between the limits of unvarying species, than the slight differences produced by the intervention of man amongst domesticated animals, and perhaps cease to be so confident as they seem to be, that these differences are trustworthy indications of the variability of species." It is, no doubt, desirable that Mr. Darwin and his supporters should not remain in ignorance of the "astonishing phenomena" connected with the transformations of the Salpæ, Medusæ, &c., though it is not clear why these changes should be more astonishing, *except to those to whom they may be novelties*, than the transformations undergone by insects; but, in the matter of the argument, the illustration given by M. Agassiz

is altogether wide of the mark, for the simple reason that the transformations of the Medusæ are not varieties at all, any more than the caterpillar is a variety of the butterfly. *

Mr. Higgins then quoted some passages from a paper in the *National Review*, in defence of Mr. Darwin's theory. He also gave an outline of an article by Mr. W. Hopkins in *Fraser's Magazine*, for June and July, 1860, which he thought to be, on the whole, the best and most philosophical review of the subject he had seen. The following is an extract from it:—"At what period of his progressive improvement did man acquire the spiritual part of his being, endowed with the awful attribute of immortality? Was it an accidental variety seized upon by the power of natural selection and made permanent? Is the step from the finite to the infinite to be regarded as one of the indefinitely small steps in man's continuous progress of development, and effected by the operation of ordinary natural causes? We can scarcely suggest these questions without an apprehension of their being deemed irre-

* Since writing the above, I have had the advantage of hearing Dr. Collingwood read an able and interesting paper in defence of M. Agassiz' criticism. On further consideration, my first impressions are, however, confirmed. The greater the eminence of the writer, the more deeply it is to be regretted that he should adopt the tone of M. Agassiz, who thus characterizes Mr. Darwin's work:—"Instead of facts, we are treated with marvellous bear, cuckoo, and other stories. Credat Judæus Apella!" No mere vulgar raillery could be half so offensive as the following:—"I apprehend that the meaning of the words he (Mr. Darwin) uses has misled him into the belief that he had found the clue to phenomena, which he does not even seem correctly to understand." The charge of materialism against Mr. Darwin's work I have elsewhere attempted to meet. Such an assertion as "the powers to which Darwin refers the origin of species can design nothing," was not to be expected from M. Agassiz. Whatever, on any physiological hypothesis, may be the differences or resemblances subsisting between embryos, to say that adults differ more than embryos, and to attempt to found on this observation a scientific proposition, appears to me to be as unphilosophical as anything that can well be conceived. The transformation of Acalephs are not, it is true, strictly analogous with those of insects, because the transformations of the former animals are complicated with the process of reproduction by division, peculiar to lowest forms of life. In both insects and Acalephs, however, the transformations are strictly confined to a limited cycle, and such transformations have, therefore, not even the remotest analogy with the "variations" of which Mr. Darwin writes. I do not pass on to notice other points, because it was not my object in writing to censure M. Agassiz' criticism, but only to express an opinion on his and other reviews of Mr. Darwin's theory.

H. H. H.

verent. But they force themselves irresistibly upon us in considering these theories in regard to their legitimate and almost necessary extension to man. The difficulty of passing, according to any theory of development, from the finite to the infinite, from the mortal to the immortal, cannot be avoided by any advocate of such theories, except by denying the immortality of man or admitting that of a sponge or a polyp."

Mr. Higgins, after noticing several other articles, referred to one appearing in the *Annals and Magazine of Natural History*, for February, 1860, and continued as follows:

The reviewer asserts "it is quite evident that there is an idea involved by naturalists in the term species, which is altogether distinct from the fact of mere outward resemblance, namely, the notion of blood-relationship, acquired by all the animals composing the species through a direct line of descent from a common ancestor." Therefore, the reviewer argues "it is no sign of metaphysical clearness, when Mr. Darwin refuses to admit any kind of difference between genera, species, and varieties, except one of degree." I do not think the idea of blood-relationship is necessarily involved in the term species, unless we go so far as to assume that all species have respectively sprung from a single pair. Most naturalists would probably agree with M. Agassiz, that, on the first appearance of a species, many pairs were created, though an exception may be made in the case of man. Now, between the many pairs of the same species simultaneously created, we do not see how blood-relationship can be assigned; the location of their descendants in a species has been founded on their nearly perfect resemblance to each other; other groups, having less perfect resemblance, together with them, form a genus; the distinction is, therefore, one of degree only. The reviewer continues,—"To our mind, indeed, the whole theory of natural selection is far too utilitarian;" and

he instances the difficulty of conceiving the exquisite varieties of pattern on the wings of many insects to be the result of natural selection founded on advantageous differentiation. This is a view of the subject in which I heartily concur. Many insects are very variable in their colouring; the common currant-bush moth for example; yet, from the number of intermediate specimens, there is reason to believe the extreme varieties breed freely together. Distinctions between other species are founded on the most minute differences in the pattern; amongst these no intermediate forms are found, and there is reason to believe that, though hardly distinguishable from each other, the individuals of such closely allied species, differing only in a speck of colour, never breed together. Now, according to Mr. Darwin's theory, these closely allied species diverged from a common point, in starting from which their differences were even less than at present, and so a fraction of a speck of colour is supposed to have given them the victory in the battle of life, to have prevailed to the extinction of intermediate forms, and to have set them so far asunder that they never breed together. I can, therefore, fully enter into the difficulty urged by the reviewer, founded on the altogether utilitarian basis of the theory of natural selection. But I cannot agree with him when he points to the exquisite beauty of the wings of insects, and asserts that no such surpassing loveliness could have arisen from natural causes. What are natural causes, after all, but the instruments used by the Omnipotent mind—the very chisel and the paint-brush of the infinite artist? A flower is, in every particle, the expression of a thought entertained in the creative mind before the plant was brought into existence. Is it less so because, instead of calling the herb into life and beauty instantaneously, the Creator sets in motion agencies which produce the result only after the lapse of thousands of ages? I do not say this has been His method, but only that I see in it

nothing unworthy of Him. When, therefore, the reviewer speaks of Nature as a "pestilent abstraction," he seems to me to use intemperate language: Nature is but the expression of a portion of the Creator's mind. We need some word to indicate that wondrous train of causes and effects between which we, by investigation, are able to discover some connexion. Nevertheless, it has been the fate of every attempt to advance this kind of investigation to meet with the charge of impiety. It may be worth while to examine the condition of mind implied in an author who speaks of Nature as a pestilent abstraction. How Nature can be an abstraction at all it is hard to see. Man may succeed in representing the Creator as an abstraction; and it is quite possible that, identifying Him with qualities repugnant to all that we know of Him, the false notions of some respecting Him may be little else than a pestilent abstraction; but how in Nature, made and upheld by Him who is wisdom and power, and who names himself by a still more touching attribute; how in all Nature, from the universe to an atom, there can be anything deserving to be called a pestilent abstraction, may be plain to the reviewer, but we may, perhaps, hesitate in considering such perspicacity a valuable qualification for a writer on Natural History. The review before us is not, however, characterized by anything like general unfairness. There is a want of strict logical accuracy in many passages; but others are written in good feeling and apparent candour, as an instance of which I may, in conclusion, quote the reviewer's estimate of the value of Mr. Darwin's theory. "There is a reasonableness about it which commands our respect. It enables us to account for many a trifling variation which, because permanent, naturalists have usually regarded as of necessity aboriginally distinct, and smooths down some of the minor controversies concerning the value of minute modifications, which may properly be referred to direct agencies from without. Indeed, we will go a step

further and affirm there is no reason why varieties, strictly so called, though too often, we fear, mistaken for species, and also geographical sub-species, may not be gradually brought about by this process of natural selection; but this unfortunately expresses the limits between which we can imagine the law to operate, and which any evidence, fairly deduced from facts, would seem to justify. It is Mr. Darwin's fault that he presses his theory too far."

Mr. Higgins expressed his intention of resuming the subject at a future meeting of the society.

Dr. Collingwood said that he could scarcely coincide with Mr. Higgins' estimate of Agassiz' criticism, which to him, appeared the most damaging and the most conclusive one which had yet appeared. Twelve months ago, when Agassiz' "Essay on Classification" was under discussion in that room, he (Dr. Collingwood) had expressed his opinion that it would be highly useful in counteracting the impression likely to be produced by the forthcoming work of Mr. Darwin, whose views he had heard expounded at their first announcement before the Linnæan Society. Having since read the book, and the reviews upon it, and heard discussions among able men upon its merits, he had formed an opinion, and not a hasty one, for during the past twelve months it had undergone more than one phase of doubt. That opinion was not favourable to its stability or general application. The arguments of Darwin were specious, and urged with so much earnestness and evidence of his own belief in their validity, that they were liable to carry away the reader at first, until consideration and cooler judgment came to his assistance. He (Dr. Collingwood) had intended to have entered upon the subject this evening, but, having been unprepared for so unfavourable a criticism upon the remarks of Agassiz as they had just heard, he did not feel willing to enter upon his defence at once, but wished more carefully to read his statements, and more deliberately to weigh them, and to have the advantage of placing his own thoughts in writing. He regarded, however, the works of Agassiz and Darwin as entirely antagonistic; and considered that the idea of a *species*, as given by the former, who considered it a life-history, embracing all the individuals composing it, their habits and economy, was a noble one, contrasting most favourably with the Darwinian hypothesis of *transmutation*, for such it was, although his supporters disliked the name.

The PRESIDENT said he hoped Dr. Collingwood would favour the society with a defence of Agassiz' remarks,—which the latter promised to do.

Mr. MORTON remarked that the lines formerly regarded as separating geological systems were gradually becoming more and more indistinct, as the result of increasing knowledge. In the British strata, the close of the Cretaceous system marks the most important break. The Permian rocks seem to pass insensibly upward into the Trias, though the absence of organic remains excludes any definite conclusion. With regard to all the other systems, there is certainly a gradual change in the prevailing species, so that although in some cases species appear to have been suddenly introduced, the general inference is, that the introduction of new species was very gradual. Hence, the difficulty geologists now find in deciding the limits of systems.

In reply to a remark that few scientific men of eminence had given a distinct opinion of Darwin's work, Dr. COLLINGWOOD read an extract from the address of Sir Charles Lyell to the Geological Section of the British Association at Aberdeen, in which he spoke of Darwin's theory as throwing a flood of light upon many groups of phenomena which had not hitherto been attempted to be explained. He also exhibited specimens of Lingula from the Lower Silurian rocks, and recent Lingulæ from the modern seas, remarking that that Mollusk was a living testimony against Darwin's theory, inasmuch as it could hardly be conceived that, if natural selection had been at work for the countless ages which had passed between the lowest fossiliferous periods and the present, the Lingula should have profited so little by it as not merely to be *not* developed into some higher form, but to remain a Lingula in no respect superior to its Silurian ancestors.

Mr. DUCKWORTH observed that starfishes were found in the Upper Silurian that exhibited no perceptible marks of difference from those existing in the present day.

The Rev. J. ROBBERDS deprecated the *odium theologicum* being cast upon the subject. He was glad to hear the President concurred with him, for he conceived that either theory was equally compatible with the reverence due to the Almighty.

THIRD ORDINARY MEETING,

ROYAL INSTITUTION, 12th November, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Messrs. PHILIP H. RATHBONE and CHARLES SPENCE were elected members.

The PRESIDENT announced the decease of Mr. Richard Rathbone, one of the original members of the Society. Three, only, of these now remain, viz., Messrs. William Rathbone, J. Houlbrooke Smith, and Dr. Traill, of Edinburgh—the last a Corresponding Member.

Dr. IHNE proposed a new mode of Shaksperian reference. Several plans had been adopted which were more or less open to objection; thus, the number of the scene was sometimes given, but scenes were occasionally very long, even as much as five or six pages. It was not practicable to use the same mode of concordance as was adopted for classic authors, namely, the number of the line, because, in dialogues, a line was not unfrequently occupied by two interlocutors, and was consequently printed sometimes as one, sometimes as two lines; besides which, prose was often interspersed with verse. Dr. Ihne thought, however, that if the *number of speeches* in each scene were counted, and a reference given accordingly, the difficulties which met the student of Shakspere in the ordinary concordance would be obviated.

Mr. MOORE exhibited a living specimen of the Menobranchus (*Necturus maculosus*), a very remarkable animal from North America, whence it was brought by Mr. P. P.

Carpenter of Warrington, and placed in the Free Public Museum. It belongs to the very anomalous order of *Perennibranchiate Amphibia,* in which the gills remain external throughout life. There are but four known genera of this very curious group, the remaining three being, the *Axolotl,* the *Proteus,* and the *Siren,* examples of each of which genera were exhibited by Mr. Moore, preserved in spirits.

A paper was then read, of which the following is an abstract: *

ON "CAPTAIN SPRYE'S SCHEME OF COMMUNICATION WITH WESTERN CHINA, THROUGH PEGU AND BURMAH."

By H. DUCKWORTH, F.R.G.S., F.G.S.

The object of this communication was to give a summary of a project recently placed before the Government and commercial community of this country by Captain Richard Sprye, formerly an officer in the H. E. I. C. service.

In his prefatory remarks the author observed that our most recent acquisition of territory in Burmah, or rather in Pegu, had brought us within some 250 miles of the Chinese frontier.

There being no direct communication between the two countries, it became a most important question whether it would be possible and profitable to establish one.

The seven most western and inland provinces of China proper are situated between about 22° and 42° north latitude, and lie far west of the extreme point to which Lord Elgin proceeded up the Yang-tse-kiang.

The chief natural productions of Yun-nan (area, 107,969

* This paper has been separately published by the Author. London: G. Philip and Son, 32, Fleet street. 1861.

square miles; population, 8 millions) are rice, silk, musk, various kinds of drugs and tea. Gold, copper, lead, cinnabar, and orpiment are abundant; indeed, Yun-nan excels all the other provinces in its mineral wealth.

KWANGSEE (area, 78,250 square miles; population, 10½ millions) produces abundance of rice, cassia, and valuable furniture-woods. Gold, silver, and quicksilver are the principal minerals.

KWEICHOO (area, 64,554 square miles; population, 7½ millions), yields wheat, rice, musk, tobacco, cassia, and precious timber; and lead, copper, mercury, and iron are found in its mountains.

HOONAN (area, 73,000 square miles; population, 33 millions) is one of the richest provinces in the empire, and produces immense quantities of grain, principally rice. Its teas are said to be remarkably fine. Iron, lead, and coals are abundant; and the mountains produce fine cassia, and various other kinds of timber.

SZE-CHUEN (area, 166,800 square miles; population, 30½ millions) is the largest, and, according to Abbé Huc, the finest province in China. Its fertility is such that it is said the produce of a single harvest could not be consumed in it in ten years. Its principal productions besides grain, are indigo and various tinctorial plants, fine teas, silk, sugar, grasscloth fibre (Boehmeria nivea), and many kinds of valuable drugs.

The climate of SHENSEE (population 14½ millions) is too cold for rice and silk, and their place is supplied by wheat and millet. Rhubarb, musk, wax, red lead, coal, and nephrite, are the principal articles of exportation.

KANSU (population, 22 millions; area, with the last, 154,000 square miles) produces wheat, barley, millet, and tobacco of very superior quality. A large traffic is carried on between this province and Tartary in hides and coarse woollen cloths.

The means of reaching these seven rich and densely popu-

lated provinces from the Bay of Bengal is very simple. Taking Rangoon as the starting point, it is proposed to connect that port with an emporium in the north-east corner of Pegue, *i.e.*, under the magnificent Karen Hills, at the most extreme north-eastern limit to which we can lay claim. From this emporium, which would be almost equi-distant from Rangoon and the Chinese frontier, the line of communication would pass through Burmah-Shan territory to Esmok (or Szemaou), a border town of Yun-nan, and a point at which several caravan roads converge directly from various parts of the province, and indirectly from the whole of the western half of the empire.

In order to take in chief towns and our military stations, the line would proceed thus:—1st stage, Rangoon to the ancient city of Pegue—the intervening country being almost level. 2nd stage, from Pegue over flat land, across the Sittang River to Shoe-Gyen. 3rd, Shoe-Gyen up the left bank of the Sittang and Kyoukkee rivers to Baukatah, a distance of 35 miles (lat. 18° 08′ 13″, lon. 96° 48′ 45″). 4th, from Baukatah up the left bank of that river, and its tributary, the Peemabhu, to Thayet-peen-keentat (lat. 18° 21′ 13″, lon. 97° 02′ 00″), also 35 miles. 5th, Across the water-shed between the Sittang and Youngsalen to the Kwestookee branch of the Thaiboot river, and down their right or left banks to the Youngsalen, down and across which, to Tseekameedac (lat 18° 25′ 58″, lon. 97° 19′ 00″). 6th, thence over the water-shed between the Youngsalen and the Salween to our frontier line under the Karen Hill country, where we are within reach of all the Chinese and Shan caravans which traverse the countries north-east and west of that point.

Another most important and prominent feature in the project is the establishment of an electro-telegraphic communication along the whole route. The line, once brought to Esmok, could be easily carried across country to the Pearl River, and

down the lower valley of that stream to Canton and Hong Kong; and, thence, taking the principal towns along the coast (Amoy, Foochow, Ningpo, and Shanghae) to Pekin.

In like manner, by extending the communication to Niew-chiang, and down the Corea, the open ports of Japan (Nangasaki, Kanagawa, and Hakodadi) might be brought to the very door of Rangoon, which already possesses telegraphic connection with Calcutta.

FOURTH ORDINARY MEETING,

Royal Institution, 26th November, 1860.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Jas. Kenworthy, M.D., and Mr. W. H. Tooke, were elected members.

Mr. Moore, of the Free Public Museum, exhibited some very remarkable living specimens of leathery turtles (*Trionyx ferox*), brought from Savannah by Captain Mortimer, of the ship "Florida," and deposited by him in the Museum.

The President remarked that excellent opportunities were frequently afforded to the numerous captains trading from this port of bringing specimens for the enrichment of the Museum. He wished, as there were in the room several influential gentlemen connected with shipping, that they would make it known to their captains that the committee of the museum would always be willing to defray the expenses of bringing such specimens, and would be very glad to encourage their being brought.

It was suggested that captains required some instructions to know what to bring, as they were liable to be laughed at, and receive no thanks, if they brought well known and common specimens.

Mr. MOORE said that he had prepared a manual of such instructions, which was ready for the press; meanwhile, he would be glad to give every information in his power to sailing-masters, and would promise them that whatever they brought they should not be laughed at for their trouble.

Mr. FABERT exhibited some very rare and perfect specimens of red coral (*Distichopora coccinea*) from the lately discovered Gambier island. The coral itself was first described by Dr. Gray, about two years since. The polyps forming this coral, as was remarked by the President, are of a lower organization than those forming white coral; and differ from them in structure, and in invariably possessing eight tentacula. Mr. Fabert also exhibited several interesting shells of the genus Cypræa; a remarkable land shell (*Helix Busbeii*), found on the tops of trees in New Zealand; very interesting specimens of Janthina, with their floats of eggs; and a singularly fine specimen of the parasitic Fungus, Sphæria entomorhiza, growing from the head of a caterpillar, and in excellent fructification.

The following paper was then read:—

ON SOME RESULTS OF THE *ROYAL CHARTER* STORM.

By THOMAS DOBSON, B.A.,

(Head Master of the School-frigate "Conway.")

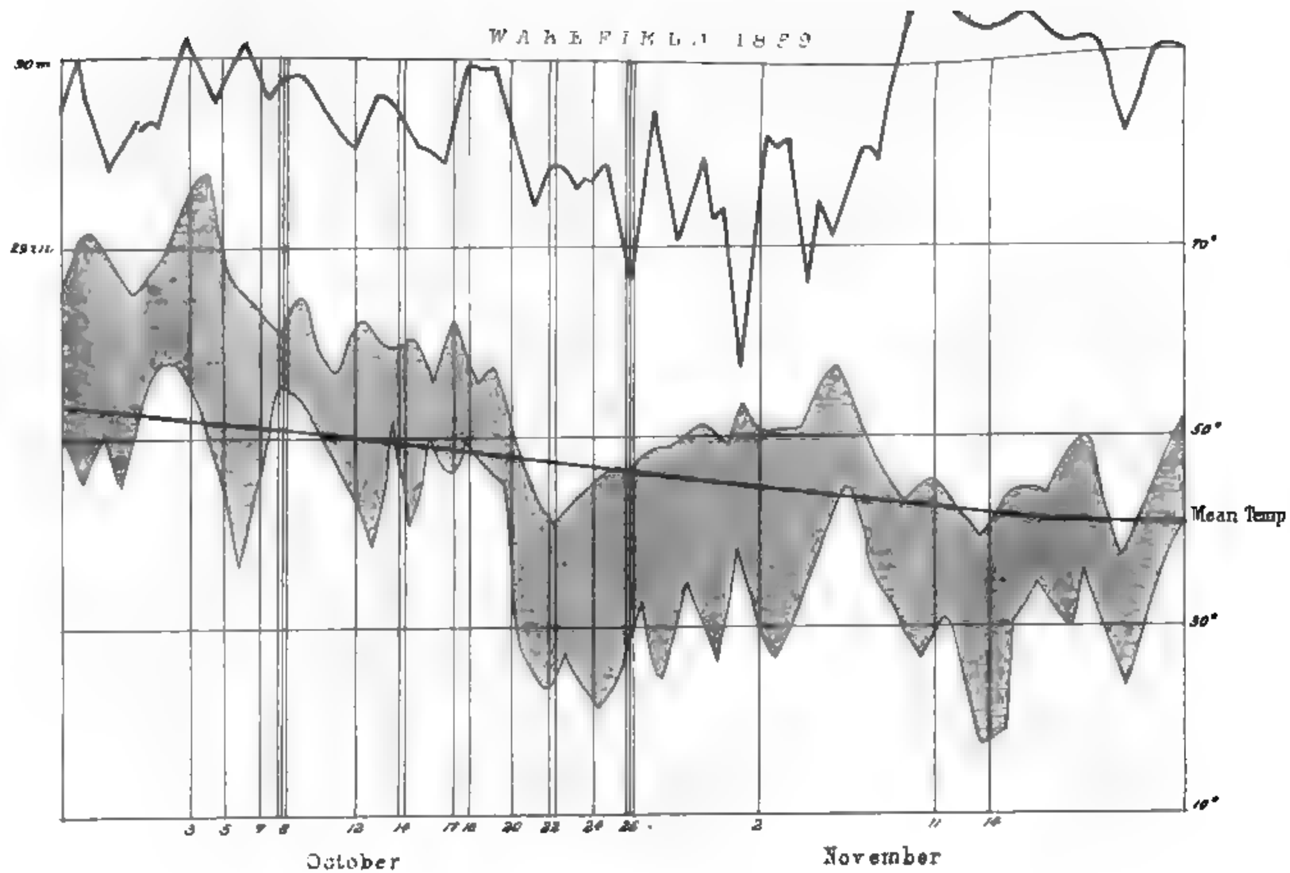
In examining the results of the bad weather in the months of October and November, 1859, I shall notice very briefly the effects on shipping of the excessive motion of the air; and direct my attention chiefly to some of the less known consequences of the extreme changes in the air's pressure and temperature during the great atmospheric paroxysm of which the "Royal Charter" storm was only a portion.

I have constructed the curves of the pressure, and of the maximum and minimum temperature, of the air, from continuous observations made every six hours, during the months of October and part of November, at Kew, at Wakefield Prison, at Stonyhurst College, Lancashire, and at the Bishop's Rock Lighthouse, Scilly Islands. The character of these curves is so nearly identical that I have selected the Wakefield curves as exhibiting a fair type of the state of the atmosphere as to pressure and temperature over the whole of England at that time.

The dark line in the diagram * represents the vertical fluctuations of the barometric column of their actual dimensions: the upper boundary of the shaded zone denotes the maximum temperature, and the lower boundary the minimum temperature, as determined by self-registering thermometers. An inch of vertical space is here equivalent to 20° Fahr., and one-tenth of an inch of horizontal space to twenty-four hours.

The Admiralty Register of Shipwrecks on the coasts of the

* See Plate I.


WAKEFIELD 1859
30 in
29 in
70°
50°
Mean Temp
30°
10°
3 5 7 8 12 14 17 18 20 22 24 26
2 11 14
October
November

United Kingdom in 1859 gives a comprehensive view of the effects of the storms of wind of that year on shipping; and the Reports of the Government Inspectors of Mines supply the dates of the fatal explosions of inflammable gas in these mines for the same period. To these dates I have added those of eight fatal cases of suffocation in coal-mines by fire-damp and choke-damp, as such cases are as significant as explosions of the unusual presence of gas in the mine at the time of their occurrence. The marked coincidence in time of the greatest atmospheric disturbance during the year, and the occurrence of the greatest number of fatal accidents from gas in coal-mines, is striking and instructive.

In the year 1859, there were 139 vessels totally lost on our coasts, and of these wrecks, 77 took place between the 21st of October and the 9th of November. If this period of nearly three weeks be omitted, the total losses during the remaining forty-nine weeks of the year amount to 62, giving a weekly average of less than 2 total losses, whereas, the weekly average is 26 for the three weeks just mentioned.

The number of lives lost by shipwreck on our coasts in 1859 was 1,645, of which 877, or more than one-half, were lost in the same three weeks. The number of fatal accidents in British coal-mines, by accumulation of noxious gas, also rises far above the average in the month of October, 1859. There were in all 81 fatal accidents, of which 18 happened in October, leaving an average of less than 6 for each of the other months of the year.

The diagram shows that from the 1st to the 19th of October, the atmospheric pressure did not vary greatly, but the temperature of the air was far above the average (49° F.) for October. The effect of such a long sequence of very warm days and nights in checking the ventilation of mines is shown by the occurrence, within 18 consecutive days, of 12 fatal accidents in eleven different localities. These were:—

On October 3rd, Bilston, explosion;
„ 5th, Seacroft, Leeds, explosion;
„ 7th, Dudley, suffocation by choke-damp;
„ 8th, Pendlebury, Lancashire, explosion;
„ „ Prescot, St. Helens, explosion;
„ „ Robart's Town, Leeds, explosion;
„ 12th, Newport, Shropshire, explosion;
„ 14th, Aberdare, South Wales, explosion;
„ „ Heaton, Northumberland, suffocation by choke-damp;
„ 17th, Rowley Regis, Staffordshire, suffocation by sulphur;
„ 18th, Rowley Regis, Staffordshire, explosion;
„ 20th, Hampstead, Staffordshire, suffocation.

No shipwrecks in British seas are recorded between the 1st and 21st of October.

On the 20th, the temperature falls suddenly as much below the monthly mean as it had previously been above it. Much snow fell in North Wales, in the North of England, and in Scotland on that day. On the 21st several waterspouts were seen at the Isle of Man; and on the 22nd there was a very severe storm of thunder, lightning, and hail at Liverpool; several distinct shocks of earthquake were felt in Cornwall and in the west of England; and the barometrical column fell three-quarters of an inch.

Such were some of the premonitory symptoms of one of the most remarkable disturbances of the atmosphere in our time, which, beginning on the 19th of October, did not subside until about the 12th of November.

Having copied, early in November of last year, the sheets on which the direction and force of the wind, during the 25th and 26th of the preceding month, had been traced by the anemometer at the Liverpool Observatory, I concluded from these data alone, that the storm, which has now acquired a painful historical interest in connexion with the loss of the "Royal Charter" steamship, was a revolving whirlwind, or cyclone, travelling to the northeastward: an opinion fully confirmed both by my own researches and those of others. The

anemometer shows that the wind began to blow here at noon of the 25th, from the eastward, veering continuously from east to north, up to 6, a.m. of the 26th, when there was a dead calm for an hour; after which the wind rose again at north, and veered rapidly to the northwest; increasing in force until 11, a.m., when it blew hardest here, the anemometer registering a pressure of 28 lbs. Avoirdupois on the square foot. These shifts of wind prove the storm to have travelled to the eastward of north, and the central track to have been to the eastward of Liverpool. The mercurial column at Wakefield fell to 28·83 inches about the time that the wind was strongest here.

It may conduce to a just appreciation of the fluctuations of the barometric curve to state, that the sharp vertical depression of this curve, on the 26th October, is the barometrical exponent of 69 shipwrecks, involving a loss of 796 lives; and of three fatal colliery explosions, induced, in all probability, by the sudden overflow of inflammable gas released from the coal and "goaves," by the greatly diminished atmospheric pressure.

On the 31st of October, the mercurial column again falls below 29 inches, and at 9, a.m., of the next day reaches a minimum height of 28·39 inches. The corresponding depression in the curve symbolizes one fatal colliery explosion and fourteen shipwrecks. The localities and dates of the fatal explosions of gas in mines, from the 20th of October until the end of this remarkable period of stormy weather, are:—

October 22nd, at Washington, Durham;
" " at Dean Hall, Leeds;
" 24th, at Crook, Durham;
" 26th, at Longton, Staffordshire;
" " at Tipton, "
" " at Tolcross, West of Scotland;
November 2nd, at Royton, Lancashire;
" 11th, at Donnington, Shropshire;
" 14th, at Dukinfield, Cheshire.

At the conclusion of this paper Mr. Dobson made some oral remarks (illustrated by diagrams) upon Sir John Herschel's *Theory of Cyclones*, as described in the "Outlines of Astronomy." Mr. Dobson pointed out the chief features of cyclones, which a true theory was bound to account for; and he explained the principle by the operation of which the trade winds are caused. Sir John Herschel's theory was, that cyclones are formed by an extension of the same principle, which he called the *law of gyration*. But inasmuch as this principle is least efficient at the equator, where almost all the great hurricanes are first formed, and where they are most violent, it did not appear to Mr. Dobson to afford any satisfactory explanation; and, moreover, it fails altogether to account for the progressive motion of cyclones.

Mr. Dobson having announced that he had brought with him Captain G. Jinman,* a gentleman of much practical experience, who was an opponent of the *Circular Theory of Storms*, the President invited him to state his views, which he did with much clearness.

Captain Jinman said: As it would occupy too much time to detail all the circumstances which led me to doubt the truth of the *Circular Theory of Storms*, I shall be as brief as possible. Having frequently to pass over those parts of the globe where they are most frequently met with, I made myself thoroughly acquainted with all that had been written on the law of storms. And, previous to meeting a hurricane, I conceived that I was thoroughly posted up in the matter, and that I could manœuvre in one with all the ease imaginable. Practical experience, however, soon dispelled this idea, and

* Captain Jinman's views have since been published in a separate form, in a work entitled "Winds and their Courses; or a Practical Exposition of the Laws which Govern the Movements of Hurricanes and Gales." G. Philip & Son: London and Liverpool, 1861.

convinced me that either I had yet much to learn, or else that the principles laid down by Redfield, Sir William Reid, Piddington, and others, were far from being correct. These principles are, that hurricanes, typhoons, &c., are nothing more nor less than great whirlwinds, winds blowing in circles round a calm centre; and, consequently, that this centre always bears about eight points from the direction of the wind—that near it will be found the greatest force of wind—that the centre is the principal part to be avoided on account of its being the most dangerous, from the sudden shifts of wind, or calm, and heavy cross sea to be met with at that point. The analysis of data obtained from ships which had been involved in storms from time to time tended somewhat to confirm these views; and, consequently, the *Circular Law of Storms* became *apparently*, an established fact. On these principles, rules were laid down for the guidance of shipmasters, by which, it was said, we might *easily* avoid the most dangerous part of a storm. To those whose avocations did not require them to put it in practice, the circular law appeared feasible enough; whilst the rules were so simple that a person of the most ordinary capacity, it was argued, might understand, and be able to apply them when necessary. As I have before observed, I made myself acquainted with these rules; and, as opportunities offered, I endeavoured to put them in practice. But the results were anything but satisfactory; for not unfrequently I appeared to meet with the centre (sudden shift of wind or calm) when I imagined myself to be far away from it. Feeling satisfied that there was something wrong, I resolved to examine carefully the various logs and other data which had been published. I was quite prepared to find *a few* discrepancies and anomalies; but I was certainly not prepared to find in the details of every storm the most glaring proofs of the fallacy of the circular law. Judge of my surprise when, on examining the works of Sir William Reid, I found that there was scarcely a

track laid down on his charts which agreed with the shifts of the wind experienced by the ships, or at places involved. For instance, in the Barbadoes hurricane of 1831 the wind is reported to have blown for a time at Barbadoes, from the N.E., shifting suddenly to N.W., and bearing to west, S.W., south, and finally to S.E. and E.S.E.; yet the track on the chart is about W.N.W. Whereas, according to the rules laid down, the shift from N.E. to N.W. should give a due north track; from N.W. to S.W., a due west one; and the final shifts from S.W. to south, S.E. and E.S.E., about S. by E. If similar discrepancies or anomalies were to be found in a few cases only, I should have thought but little of the matter; but, as I have before observed, they are to be found in the details of every storm. Yet, notwithstanding those evident proofs of the fallacy of the principles advocated, we have been told that we may easily ascertain the track of, and avoid, a storm by adopting them. The most unqualified abuse has been poured forth on shipmasters in general, and those in particular who have had their ships damaged by storms. Mr. Piddington, the great cyclonist, has even gone so far as to imply that shipmasters are in the habit of running their ships into hurricanes. Seeing those proofs of its fallacy, I threw the *Circular Theory* aside, and scarcely rested night or day until I had got hold of what I believe to be the right clue. And I now assert, and am prepared to prove, that there never has been such a thing as a really *circular storm*, or one which will bear out the principles laid down by Redfield, Sir William Reid, Piddington, and others. Every hurricane or gale is formed by the joint action of two distinct currents of air flowing in opposite directions, and crossing each other at two points—one on each side of the centre. The two sides are distinct—seldom equally developed at the earth's surface—and seldom blow with equal force. The centre is not the most dangerous part of a storm; the greatest force of wind is

invariably at some distance from the centre under the points of crossing, or where one current forces its way under the other. Sudden shifts of wind and calms are met with at the points of confluence as well as at the centre; and the greater portion of those ships which have been reported to have run into the centre never were near it.. A ship may stand into the centre of a storm, from one side, carrying topgallant sails, and yet be reduced to bare poles in passing out on the other. The consequence is that lives and property are being sacrificed, almost daily, by being plunged headlong into the most destructive parts of hurricanes, through those in charge being misled by the absurd and dangerous *Circular Theory of Storms.* In proof of this, I have but to refer to the case of the "Royal Charter." The anemometrical records of the Liverpool Observatory clearly show that previous to the calm, between six and seven. a.m., of the 26th, the greatest pressure was only 5 lbs. to the square foot; whereas, at noon, five hours after the calm, the greatest pressure was about 28 lbs. Consequently, a ship might have stood into the centre of that storm with a pressure of only 5lbs. on one side, and have met with a pressure of 28lbs. in coming out of it. If a storm is formed by one continuous current of air flowing round a centre, and if the sudden shifts so often reported occur only at the centre, how is it that the temperature and general appearance of the weather change so suddenly, as they often do, when a shift of wind occurs? I have known the thermometer to fall 20° in less than as many minutes, when a shift of wind has occurred in the Atlantic. Is it reasonable to suppose that the cool current entered was the same as the one quitted, and that it had changed its temperature whilst passing round the centre, or in the space of a few minutes? Surely not. The temperature, appearance of the weather, and force of wind, are seldom the same after the shift as before it; clearly proving, as I maintain, that a

hurricane, or gale, is formed by the joint action of two distinct currents of air, and not by one continuous one. It may be said that ships have escaped by adopting the rules laid down. True, but it can easily be shown how two ships may be overtaken by the same storm; both follow these rules, and one may escape by so doing, whilst the other is plunged headlong into the heaviest part of it.

Captain Mortimer agreed with much that Captain Jinman had said. He once thought that it would be very easy to sail out of a gale by the directions contained in the various works upon cyclones, and formerly had a great respect for Piddington's Horn-book; but experience had made him gradually lay them on the shelf. He believed that the spiral direction given to the wind arose in a great measure from the backing-up of clouds, and from the form of the coast line against which the wind impinged.

FIFTH ORDINARY MEETING.

ROYAL INSTITUTION, December 10th, 1860.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

The following gentlemen were elected members:—

Mr. JAMES ALEXANDER,

The Rev. HERMANN BAAR, Ph.D.,

Mr. JOSEPH LEYLAND.

Mr. MOORE exhibited, on behalf of Captain Jinman, a remarkably fine group of the shells called *Magilus antiquatus*, from the Kooria Mooria Islands.

The PRESIDENT remarked that the gregariousness of the species was not generally known.

Mr. MOORE read a portion of a letter from Mr. S. Archer, Surgeon, H.E.I.C.S. (late of Rodney-street), dated from Cashmere, in which he mentioned the interesting fact that he there found in abundance the butterfly so well known in this country as the "clouded yellow" (*Colias edusa*).

The SECRETARY drew attention to an article in an Australian paper, the *Brisbane Guardian*, entitled "Cotton and Queensland," in which the eminent capabilities of that country as a cotton-growing district were advocated by Mr. W. Brookes.

The following paper was then read:—

ON LIFE ASSURANCE: REGARDED AS AN INVESTMENT.

By J. BIRKBECK NEVINS, M.D., Lond.

The subject of Life Assurance is so extensive that I shall confine myself in the present paper to a very limited portion of it; and shall consider it chiefly in its bearings as an investment, under the following heads:—

1st. *The Value of Life Insurance, regarded simply as an Investment for such small sums as the Annual Premiums generally amount to.*

2nd. *The circumstances which have operated to limit the extension of Life Assurance, notwithstanding its acknowledged advantages.* And

3rd. *To point out the measures by which it appears that those obstacles may, to a great extent, be removed, and the benefits of Insurance more widely diffused.*

1st. *The Value of Life Insurance, as an Investment.*

The object of this section is to show *the superiority of this method of investing small sums over any other that is within our reach;* and, for this purpose, we shall take the ordinary circumstances under which Life Assurance is now carried on by offices of average respectability and standing; and assume that a person at 30 years of age is able to spare the small sum of £5 per annum, either as an Insurance Premium, or for investment in some other way. Now, the first thing that suggests itself will be the difficulty of finding an investment for so small a sum; and even five times this amount, or £25 a-year, would, probably, in most cases, be in the bank at a mere nominal rate of interest, or would remain at home, bearing no

interest at all. But if it were invested in a Life Insurance policy, the smaller amount would at once insure the sum of £200, and the larger, or £25 a-year, the sum of £1,000, which would be payable immediately in case of death, and would, undoubtedly, form a good investment in that case.

But persons insuring their lives do not expect to die within the year, and thereby make such an excellent bargain; on the contrary, they look for an average, if not for a long, life; and more often think of the responsibility they incur in having to pay the yearly premiums, than of the post-obit advantage to their families from the receipt of money, which the paterfamilias has only handled in order to part with, to be seen by himself no more. We must, therefore, proceed on the supposition that a man will live for an average period, and have to sink his premiums for many many years to come, instead of seeing his wealth increase before his eyes, by the accumulation of yearly investments with profits, which he keeps—so to speak—in his own hands.

The following table will, however, exhibit this matter more clearly than any lengthened disquisition on the subject. I have assumed the age of 30 years for the reason that it is the most common one at present for commencing Insurance, *i.e.*, the age at which a family is beginning to grow up around the head of a house. The bonuses which are added in the third column are only such as many offices of a merely average character have proved themselves able to afford. I have also assumed, in the fourth column, that the difficulty of meeting with an investment for such small sums has been overcome, and that the money produces a steady return of 4 per cent., compound interest, which is as high a rate as can with safety be calculated upon, consistently with the essential feature of security.

The first column, then, contains the age of the person insuring.

The second, the number of years he has paid his premiums.

The third, the amount for which he is insured; which, after a time, begins to increase by the addition of bonuses.

The fourth contains the sum to which his investments would amount, year by year, with the constant addition of compound interest. And

The fifth shows the advantage in favour of Life Insurance as an investment, over the other security adopted.

The table ends with the 64th year, because at the age of 30, a healthy man has, on an average, the expectation of living 34 years to come, which will bring him up to 64; and all calculations of this kind must proceed on average principles. If a man at 30 lives longer than the 34 years which he may reasonably expect, he will, no doubt, to some extent, be a pecuniary loser by such a want of practical wisdom, as would be shown by living beyond the average age of men.

In order to avoid too many details, the calculations are only given for every second year; and the nearest shilling has been taken in the amount specified.

1st Age.	2nd No. of Years Insured.	3rd Amount Insured and Bonuses.		4th Investments, with 4 ℔ cent. Compound Interest, added. Premiums, with Interest added.			Prems. actually paid			5th Difference To Insurers.		
		£	s.	£	s.	d	£	s.	d.		£	s.
30	1	200	0	5	0	0	5	0	0	Gains	195	0
32	3	200	0	15	12	0	15	0	0	„	184	8
34	5	200	0	27	2	0	25	0	0	„	172	18
36	7	218	5	39	10	0	35	0	0	„	178	15
38	9	224	14	52	19	0	45	0	0	„	171	15
40	11	231	3	67	9	0	55	0	0	„	163	14
42	13	238	1	83	3	0	65	0	0	„	154	18
44	15	245	0	100	3	0	75	0	0	„	144	17
46	17	252	3	118	10	0	85	0	0	„	133	13
48	19	259	12	138	7	0	95	0	0	„	121	5
50	21	267	0	159	17	0	105	0	0	„	107	3
52	23	275	0	183	2	0	115	0	0	„	91	18
54	25	283	0	208	5	0	125	0	0	„	74	15
56	27	291	5	235	9	0	135	0	0	„	55	16
58	29	299	17	264	17	0	145	0	0	„	35	0
60	31	308	8	296	14	0	155	0	0	„	11	14
61	32	313	1	313	11	0	160	0	0	Loses	0	10
62	33	317	15	326	2	0	165	0	0	„	8	7
64	35	327	7	352	14	0	175	0	0	„	25	7

Thus, it is evident that for *above thirty-one years he must be a gainer by investing in a life policy; and it is only in the last two or three years that he can be a gainer by adopting any other form of investment*; and even if he should be so unfortunate as to select an office which is not able to declare a bonus at all, it is still evident that he must invest for above 24 years without withdrawing a farthing of his funds, or sustaining any loss either of principal or interest, before his accumulation will amount to the sum for which he is insured.

The amount of risk which a person sustains during the 24 or 31 years that he must be investing before his savings can equal his life policy, may, perhaps, be placed in a still more striking light by reference to the Carlisle mortality table, from which it appears that if 5642 people are alive at the age of 30, fifteen hundred of them will die within 24 years, and two thousand within 30 years. What security, then, has any individual that he will not be one of the fifteen hundred or two thousand that die, and that he will ever have the opportunity of adding to his yearly accumulations until they amount to the policy, with bonuses, or even to the naked policy, without such additions?

With one illustration further, I shall conclude this part of the subject, and it is taken from an ordinary endowment table. At the age of 14 or 15 years, the time arrives for thinking how to provide premiums for our sons' education in business; and after the age of 20, our daughters sometimes evince signs of taking flight from the paternal roof, when an unappropriated hundred pounds may be a convenience towards adorning her wings and providing orange blossoms. Now an annual payment, from birth, of £5 16s. or something under £6, will secure a hundred pounds for the boy at the age of 14, and a payment of little more than £3 (£3 4s. 3d.) a-year will secure a like sum for a daughter at the age of 21; but

the first premium multiplied by 14 only amounts to £81, *and we have, therefore, gained £19 in the hundred by that investment, and the girl's premium multiplied by 21 only amounts to £67, and we have, therefore, gained £33 in the hundred by that.** Now, it is scarcely necessary to repeat that it is difficult to find an investment for such sums as the £6, or the £3 required for the premiums; and that if these amounts happen to be in hand without any special application in view, they may possibly disappear and leave no permanent fruits behind them; whilst, on the other hand, if an insurance premium must be paid by a certain day, or loss ensue, we may even make some little retrenchment or sacrifice to provide the amount, if it does not happen to be ready without such an effort being necessary.

Here, however, we may be met by the very natural question, "If the profit be so great to the insurer, how is the office enabled to carry on a business which shall be profitable to itself also?" and the answer is to be derived from many sources, but chiefly, perhaps, from this, viz., that it is very difficult for private persons who have other engagements to occupy their thoughts, to find profitable investments for small sums, such as have been mentioned; whilst it is easy for an office—whose business, from first to last, is connected with finance—to find investments for the hundreds or thousands of pounds which an accumulation of these small premiums may amount to. It will also be seen, by reference to the table, that the average expectation of life at 30 is 34 years; and, therefore, the office will, in the long run, make a profit of £25 7s. upon the average of the lives assured; so that the advantage to the individual insurer arises from his certainty of gain for above 30 years should he be one of the unfortu-

* The premiums are returned if the child dies under the age specified. If they are not so returned the annual premium required is much less than the sum here mentioned.

nate two thousand who die early; whilst the profit to the office arises from the premiums paid by the remaining three thousand, who live, on an average, beyond the period, when their payments will be entirely swallowed up by their policies at the time of death.

2nd. *The circumstances which have operated to limit the extension of Life Assurance, notwithstanding its acknowledged advantages.*

Having thus shown the value of Life Assurance, regarded merely as an investment, independently of the arguments in its favour, derived from the uncertainty of life, and the obvious duty of making a provision for our families at death, the question must now be considered—" What are the circumstances which are in operation to prevent a more general adoption of the practice ?" These appear to be chiefly the three following, so far as I have been able to gather, either from conversation or from reading :—

1st. *Imperfect knowledge of the real advantages which Insurance offers as an Investment.*

2nd. *Doubts as to the security of the Investment.* And

3rd. *The remote period at which the Investment becomes valuable; and its unmarketable nature in the mean time.*

1st. I am under the impression that much remains to be done in the way of bringing the great pecuniary advantage of Insurance intelligibly before the public. The ordinary tables published by the different Insurance offices contain the materials for many of the calculations I have just laid before you; but I have only met with a single case in which even some of those advantages are put prominently forward, in a form appreciable by the ordinary public, without the necessity for making the calculations themselves. For instance—an ordinary

endowment table furnishes the materials for discovering the gain of £33 in the £100 by insuring a child's life for 21 years; but it is necessary to make sundry calculations before discovering the result; and a large portion of even the provident public is able to appreciate an advantage of this nature when plainly stated, although it would not think of making the calculations, because such subjects are foreign to its daily pursuits.

2nd. But a more serious obstacle arises from a feeling of doubt about the safety of the investment—that is to say—about the ability of the office to meet its engagements when the day of reckoning eventually comes; which in this particular form of investment is only after the death of the insurer; and, therefore, after he has lost all power of lessening or remedying the evil, should the office prove to be unsound. This feeling of doubt can hardly be considered unreasonable on the part of the public when we look at the history of Insurance offices; and a few years since, it rose to such a height, that, in the year 1853, a Committee of the House of Commons was appointed to investigate the subject, the result of which was a most valuable blue-book on Assurance Associations, from which much of the materials of this paper is derived. At that date, the number of Insurance offices was estimated at about 100; but "between 1844 and 1853 no fewer than 311 Insurance companies of various kinds were provisonally registered, of which only 96 continued to exist in the latter year."—Report, p. 430. Since that date, a large number of Insurance offices have come into existence, and have also disappeared; and the general result is, that from the year 1844 to the commencement of 1860, 146 Life Insurance offices have wound up their affairs, or have come to an end in some other way.*

In addition to this circumstance, a considerable number of

* *i. e.* 78 between 1844 and 1856 (see "Hand-book of Insurance," p. 61), and 68 between 1856 and 1860 (calculations from the lists in the medical directories).

the older offices did not publish any statement of their affairs, and the insurers were, therefore, entirely in the dark respecting them; and the statements which many of the new offices did publish, in compliance with the Act of Parliament, were of such a nature that Mr. Whitmarsh, the Registrar of Joint Stock Companies, informed the Committee that "a more unexplainable thing can hardly be, than the balance-sheets returned."—"I do not suppose that one person in 500 could understand any one of those balance-sheets, as they are made up."—"I should say they are rather calculated to mislead than to inform."—Report, p. 5.

It can scarcely be a matter of surprise, after this, that there should be a feeling of insecurity in the public mind with reference to Insurance offices.

It is, however, in the highest degree satisfactory to peruse the evidence of first one, and then another, of the witnesses examined before the Committee; for their independent testimony all leads to a result very different from what was expected when the Committee commenced its labours. The witnesses were actuaries and others of the highest standing, and represented both the oldest and the youngest of the Insurance offices; and amidst all the dissatisfaction with details, and the faults which they unsparingly exposed, *their evidence was almost if not quite unanimous, that the general condition of Life Assurance offices, with the exception of the* West Middlesex *and the* Security Mutual, *was sound and solvent; and that, with very few exceptions, the parties insured in them enjoyed perfect security; and when further pressed by the Committee to state whether they had known any instance of a Life Insurance office failing to meet its engagements, the answers were, almost without an exception, that they had not known of such an instance; the shareholders might have suffered, and the company might be ruined, but it had still met its engagements,* or transferred its business to another

more careful or more successful company. A few cases were mentioned by one witness in which fraudulent companies had obtained a single premium from various persons, and then broken up; but, even he added, " the only case of a second premium I ever heard of was that of B. G., but I believe his premiums were due half yearly."—Pateman: Report, p. 279, a. 3068.

The evidence, also, of the witnesses was to the effect that, generally speaking, the accounts published by the companies were capable of being understood, and although they admitted of very great improvement, they still contained much information of value to an actuary in judging of their condition. Since that date, the statements put forward, year by year, by the different companies are much more intelligible than formerly to ordinary readers; and an element has lately been introduced into the reports of some of the offices which is of primary importance with reference to the feeling of security. In the report of an Insurance company, published about 12 months since, the auditors certified that they found the books correctly kept and accurately balanced, and all the vouchers right enough; but they added that they had no means of knowing whether the assets of the company existed anywhere except in the books, for they had no access to the deeds or other securities held by the company; and they could, therefore, only say that everything was correct as far as the books showed it. On presenting this report, they were immediately authorised to examine the securities as well; and, at an adjourned meeting, they reported that the securities, as well as the books, were correct—a most important question both for the shareholders and the insurers. The primary importance of such a scrutiny—not only into the books, but also into the securities held by the company—has also been strongly insisted upon, and carefully carried out, by an actuary of the highest eminence in this neighbourhood; and the result has confirmed the well-merited

confidence which the public has reposed in the company under his guidance. We may, ere long, expect to see such an examination a regular and essential part of the report of every office, that desires to stand well with the public.

The evidence which has thus been laid before you appears amply sufficient to remove any doubts as to the soundness of the security of a Policy of Life Assurance; but there is still another means of satisfying the doubtful, which will come more appropriately under notice after taking the third objection to Life Assurance, viz.:—

3rd. *The unmarketable nature of the Investment.*

I believe that this is an objection which weighs strongly with many persons of a thoughtful and provident character, who are fully alive to the importance of providing for their families, and have considered the subject of Life Assurance as a means of doing so. Their objections may be put together in some such form as the following:—"I am at present able to insure my life, but I have no security that I shall continue able to pay the premiums; and, in that case, what I have paid will go for little or nothing; and although I have children dependent upon me now, for whom I wish to provide, they may be grown up and independent of me before I die, and I may wish to give up my policy; but if I do, I shall get nothing for it, for the companies always take advantage of people who want to sell their policies; or it may be extremely important for me to raise money upon my policy, but it is a matter of such bargaining and delay, besides the loss, that I will rather save my money, and have it by me, than insure my life."

Such as these are the objections which I have frequently heard raised by thoughtful persons upon whom Life Insurance had been urged; and it will be observed that they all turn upon the question of the difficulty of obtaining a fair surrender price for a Policy of Insurance. There is much to be said for

the office as well as for the insurer in explanation of this difficulty; but I believe that there is a prevailing feeling, whether well or ill founded, that the offices do not in general give a fair surrender value for a Policy of Insurance; and that they take advantage of the position in which the insurer is placed to offer him terms which he feels assured are much below the real value. This feeling operates, I believe, very prejudicially to the extension of Insurance amongst persons who might otherwise insure for moderate sums—such as constitute the staple of the business of many of the younger offices—for not only does the anticipation of it prevent some persons from insuring, but the annoyance which is experienced in a negotiation for surrendering a policy, leaves the insurer with little friendly feeling towards the office which he thinks has dealt ungenerously, if not unjustly, by him; and he is more likely to dissuade a friend from insuring in that office than to urge him to do so; and the company not only loses him as an insurer, but makes him a passive, if not an active, opponent.

It must be confessed that the view of the case which is thus taken by the insured finds countenance in the evidence given before the Committee of the House of Commons; for in answer to questions, several of the witnesses drew attention to the difference between the real value of a policy and the amount which the offices generally give; and whilst stating that the real value of a policy, a few years in existence, is in round numbers, about half the amount of the premiums paid, they state that the offices generally only give about two-thirds of the real value, or one-third, instead of one-half, the premiums actually paid; and that some years must elapse before they will give anything for them at all. These lapsed policies, for which nothing is given, form an important item in the accounts of some offices; and I have just seen the report of a company which has been 14 years in existence, and which states that

every claim from deaths that has occurred during the whole period of its existence has been met by the premiums paid upon lapsed policies, and there is still a balance of above £7,000 in hand from this source, *i.e.*, the insurers who will derive no future benefit from the office have borne the whole of the society's losses during 14 years, and still leave it a balance in hand.

Thus far for the complaints of the public. On the part of the companies, it is due to state that these lapsed and surrendered policies, although apparently a source of unalloyed profit, are really, in one sense, a serious loss to the company; and, moreover, that the profit is nothing, in the long run, as compared with the loss. This apparent contradiction is easily explained by reference to the mode of fixing the premiums. For the sake of convenience the amount is stated as a definite sum, to be paid year by year, but it really consists of two portions which must be carefully kept distinct after they are once paid into the office. One part of the premium is absolutely necessary for covering the risk of the life, and meeting claims by death when they become due, whilst the remainder of the premium, called the "loading," is for the purpose of defraying the expenses of management, &c., and yielding a profit to the company. Now, it is evident that if a policy lapses altogether, or is bought by the company at £50 below its real value, it gains a present advantage of this amount; but if the annual profit derivable from that premium was £10, and the insured had a reasonable prospect of living 30 years, the profit to the company would have been £300. It will, however, have lost this by the cessation of the policy; so that whilst it makes a present gain of £50 it incurs a loss of £300, which may well account for the reluctance of offices to encourage the surrender of policies.

Persons who wish to surrender their policies often think them of more value than they really are, from overlooking the

circumstance that their lives have been insured already for many years, and that they ought, in all fairness, to pay for the security they have so long enjoyed; they have, therefore, no more right to expect a return of anything near the amount they have paid, than a person insured against fire would have to expect the return of his premium because he had had no fire on his premises.

It must, however, be admitted that the insurer has grounds for dissatisfaction in receiving only two-thirds of the real value of his policy, even though the company makes far less profit on the transaction than he is apt to imagine; and it becomes a question which appears to me deserving of consideration, whether a more liberal policy, on the part of the offices themselves, would not result in substantial profit in the long run, instead of loss, by facilitating the surrender of policies by the insurers. If the companies published, along with their other tables, one containing a fair and full value for policies which had run so many years, and made these amounts payable, not after a bargain with the company but on demand, or at a short fixed notice, it appears to me that several very important purposes would be gained, of as much value to the office as to the insurer. In the first place, it would give the best possible answer to any one who doubted the stability of the office; for, on demand, he could obtain the stipulated sum, and satisfy himself, by this means, of its solvency, if he considered the satisfaction of his doubt worth the sacrifice which he would incur in withdrawing. In the next place, it would make every life policy a document of known marketable value; for, if tendered as a security, the receiver would be quite independent of everything except the amount of the policy, and the numbers of years it had run. He need not consider whether the premiums were likely to be kept up or not; for, if they lapsed, he would still, on demand, obtain the amount due for the length of time that it had been in force. The insurer

would be saved the feelings which now so often accompany the surrender of a policy; and being shown that he had received the fair value for it, he would probably be induced to re-insure in the same office, when the temporary circumstances had passed which occasioned his withdrawal; and being freed from the fears which many men now entertain lest they should become unable to keep up their premiums, and so sustain loss, he would cease to hesitate about insuring himself, and would probably promote, rather than hinder, the assurance of others.

To this it is objected, and the objection undoubtedly deserves serious consideration, that an Insurance office is, to a great extent, a provident institution; and that it might prove an injury to the insurers by producing improvidence, if policies could be surrendered with ease for an amount which might appear considerable. But it must be remembered, that under any circumstances the insurers can only expect about half the premiums actually paid; and the loss in surrendering a policy will therefore always appear considerable, and sufficient to prevent any but very thoughtless persons from surrendering their policy for the small amount it could yield: and if the public was more thoroughly instructed in the great pecuniary gain derived from Insurance as an investment, as shown in the early part of this paper, the number of those who would kill the goose that lays such golden eggs, for the sake of the surrender price of the policy, would be very small indeed. It is my firm conviction that liberality in this respect on the part of the companies, combined with tables well drawn up shewing the great pecuniary advantage of Insurance, would induce a very considerable addition to the number of Insurers; whilst the proportion of those who discontinue their policies would be very small, and would consist, still more than at present, of those only whose circumstances compelled them to make the sacrifice.

Some offices have indeed introduced the principle of

allowing a policy to expire by the cessation of payments, and granting a new one of the value of those already made; but although this is a valuable addition to the privileges of insurers it does not render a policy any more marketable or available as a security, because the holder must still wait for the death of the party before it becomes cash. There is a marvellous charm in the words,

"On demand, I promise to pay,"

which is not possessed by any talisman, ancient or modern.

In the discussion which followed, several members urged the importance of publishing tables of the surrender value of policies; upon which Mr. BOULT replied that for his own part, he was rather in favour of such a plan; but it had not the general approbation of Insurance offices at present; and there existed a strong feeling against making surrenders too easy, lest it should encourage improvidence and the too frequent discontinuance of insurances on slight grounds. He repudiated the notion that policies had no market value; for if a person wished to sell one he could send it to a London auction mart and it would fetch its value—"The value of the thing being the money it will bring."

Dr. NEVINS replied on the question whether the auction price offered for a policy did represent its true value, and showed that it did not, from the very nature of assurance principles. The entire safety of assurance depends upon the fact that, taking a large number of lives together, the good and the bad will balance each other, and, on the whole, a safe average can be calculated upon; but if a single life only is insured it may prove very good or very bad, and the transaction becomes a speculation, and not a matter of safe calculation. Hence arises the unsaleable character of policies in the market, as the purchaser of a single policy becomes a speculator on that particular life; whilst the company, having an average surrender value, would take the risk of good and bad together, and transact legitimate business instead of entering upon a mere speculation.

The following paper was also read:—

ON AGASSIZ' VIEWS OF DARWIN'S THEORY OF SPECIES.*

By CUTHBERT COLLINGWOOD, M.B.,Oxon, F.L.S., &c.

When the subject of Darwin's Theory of the "Origin of Species" was brought before this Society, a short time back, the paper of M. Agassiz, in the "Annals" of September, 1860, in which he severely criticises the views of Mr. Darwin, was prominently set forth, and characterized as "quite unworthy of so distingushed a naturalist." I then ventured to differ from the writer in this general estimate, and also to demur from the representation given of his fundamental statements; and I agreed to the invitation to defend the remarks of M. Agassiz at some future time. Since then, I have been waiting for an opportunity of laying before you a few observations upon this subject, premising that a more careful perusal of M. Agassiz' criticism has only confirmed me in the opinion I then expressed, viz., that I considered it to be one of the most conclusive and formidable (against Darwin's theory) which had yet appeared.

I know not how I can satisfactorily show the value of M. Agassiz' paper, except by taking up his principal positions *seriatim*, and endeavouring to prove their truth and logical accuracy; and this I shall hope to do, dwelling more particularly upon those points which were specially singled out for objection. Moreover, I shall not enter farther upon a discussion of Mr. Darwin's views than we are necessarily led by the subject-matter of Agassiz' criticism.

* This paper is an answer to certain statements made at the Second Ordinary Meeting of the Society, some of which will be found printed, commencing p. 42 of this volume.

And here let me premise that the criticism in question is one among a very few, which, proceeding from the pen of a profoundly scientific physiologist, and accurate observer, fairly addresses itself to the scientific and physiological aspects of the question—not repeating and corroborating Darwin's own somewhat easily appeased doubts, but attacking it at points which were not hitherto observed to be weak, and arising, as it might be almost said, accidentally, from some considerations relative to the degrees of individuality, and specific differences observed among Acalephs. There does not appear to me to be a word in this paper unworthy of, or inconsistent with, the character and attainments of the author of "An Essay on Classification," a work which, in my humble opinion, is a noble contribution to zoological enquiry, and is characterized by a solidity and accuracy of statement—a conformity with observed phenomena—a chain of logical sequence,—which favourably contrasts with the necessarily imperfect hypothesis of Mr. Darwin—with its gaps—its assumptions—and its demands upon our faith.* And this fact alone renders it, *à priori*, unlikely that the man who wrote the former should be guilty of anything approaching to petulancy or absurdity when reviewing the latter.

It would be presumptuous in the highest degree in me to consider it necessary, under ordinary circumstances, to stand forth as the apologist for one so eminent in every way as Louis Agassiz—one who is an ornament to science, and the pride of the country of his adoption. I only feel called upon to do so on your invitation, and because in the review

* It is, perhaps, necessary to state here, lest I should be misunderstood, that although by no means able to subscribe to the Darwinian hypothesis, I would not wish (as some appear to do) to condemn the whole theory as visionary and mischievous. Neither theory is capable of direct *proof*, and both are so dependent upon knowledge (not only the knowledge of an individual, but also the accumulated knowledge of an age), that I think it would betray an unworthy assumption of wisdom on my part wholly to reject the new one, virtually unheard and untested.

in question he has been charged with dogmatism and intentional obscurity. Did I think that these charges could be substantiated, I would at once lay down my pen; but I firmly believe that a candid enquiry will result differently.

M. Agassiz begins by advocating the idea—"That while species have no material existence, they yet exist as *categories of thought*, in the same way as genera, families, orders, classes, and branches of the animal kingdom;" and again, "that all the natural divisions of the animal kingdom are primarily distinct, founded upon different categories of characters, and that they all exist in the same way,—that is, as *categories of thought embodied in individual living forms*." Now, in all these expressions, I can see nothing obscure nor petulant—but, on the other hand, I *do* see the accurate reasoning of a philosophic mind, and a consistency in the support of a fundamental principle; which principle is in complete antagonism to Darwin's theory; so that there is no possibility of amalgamating the two ideas. Agassiz has, in all his works, maintained the same principle, and no one can reasonably object to his re-stating it on this occasion. But since it is complained that it is obscurely stated, let us examine whether it be not in truth logically and tersely expressed. What is a category of thought? I reply that it means a mental abstraction, in which all the predicates and all the attributes of the idea of species are arranged in an orderly series. Species exist in individuals—all the *similar* individuals existing at one time, embody the idea of a species; the individuals live—they are *objective*—they thrust themselves upon our notice as material beings—but something more than this *mere existence* is arrived at by our reasoning faculties, which *subjectively* infer that these forms represent an *idea*, which we may reasonably conceive was present with the Creator, when it pleased Him to make them, and that idea is *species*. Thus we arrive synthetically through all the characteristics of species,

so comprehensively described by Agassiz in his "Essay on Classification," at the generalization with which we imagine the Creator to have set out. Species, then, is an idea, not an entity; but an idea which sprang from the Eternal Mind.

"As the community of characters," says Agassiz, "among the beings belonging to these different *categories* arises from the intellectual connexion which shows them to be categories of *thought*, they cannot be the result of a *gradual material* differentiation of the objects themselves." I quote this passage because it was imagined, not only that it conveys no sense, but it was even suggested that the author wittingly wrote nonsense. Such a notion is to me incomprehensible; but, farther, I see in it a condensed chain of logical reasoning, which demands close study, and no superficial glance, to appreciate its whole import. The author has just been speaking of the several great plans upon which it has been demonstrated that the animal kingdom has been constructed. It has been shown by the labours chiefly of Owen, Huxley, and others, that no one plan can be constructed to which all animals are reducible. No *invertebrate* animal can be shown to be formed agreeable to the *vertebrate* plan; the molluscan and articulate plan have scarcely anything in common; and the cœlenterata and protozoa, moreover, differ in plan from either, and are probably not even mutually reducible. Here, then, community of *origin*, and community of *characters*, are not synonymous terms. There is *community of characters* in a *class*, but he distinctly asserts that "classes are founded upon different modes of execution of these plans, and, therefore, they embrace representatives which could have no *community of origin*." Moreover, in the sentence I am examining, it must be borne carefully in mind that there is an antithesis between the abstract idea, or category of thought, on the one hand, and the living embodiment, or individual forms, on the other. Bearing this in mind, let us now read the

sentence—"As the community of characters among the beings belonging to these different categories (*i.e.*, great branches of the animal kingdom, each formed upon a different plan) arises from the intellectual connexion which shows them to be categories of thought (in the sense explained above) they (that is, these different categories or abstract plans, embodied in vertebrata, mollusca, articulata, &c.) cannot be the result of a gradual *material* differentiation of the *objects* themselves." Here, the antithesis is between *intellectual*, in the first part of the sentence, and *material*, in the second—between *categories of thought* (or the idea of species) in the first part, and the *objects* (or the embodiment in living forms) in the second.* For Mr. Darwin tells us that the gradual material differentiation of individuals has given rise to all the *great plans* of structure. The whole sentence is pregnant with meaning—not a word is employed which has not a definite and necessary connexion with what precedes or with what follows; and the simple difference between the position of the writer and that of the reader is this, that Agassiz wrote the sentence with a full and thorough appreciation of all the bearings of the subject, every word being fraught with meaning in his mind, whereas, his reader having less grasp of the subject, has, necessarily to learn it by degrees, and by a dint of study of its contextual relations.

A few remarks may here be appropriately introduced upon the subject of these great plans, which appears to me to be one of the last importance.†

* "The leading objection of Mr. Agassiz is likewise of a philosophical [metaphysical] character. It is, that species exist only as *categories of thought*—that, having no material existence, they can have had no material variation, and no material community of origin. Here, the predication is of species in the subjective sense, the inference in the objective sense."—*Prof. Asa Gray, in Atlantic Monthly Magazine, October*, 1860.

† Nothing can prove more certainly the *natural* character of these four distinct plans than the fact that Von Baer and Cuvier, each of them independently arrived at the same conclusions concerning them—Von Baer, through the study of developmental changes, and Cuvier, by means of a close attention to the anatomical structure of animals.

These great plans of animal structure are not mutually reducible. However animals of different branches may agree in their *external* characters (as I showed at length in a paper read before the Society last session) no comparison can be instituted between their internal structure. No *series of forms* can be constructed, passing insensibly from one great branch to another. The highest forms of one branch are superior to the lowest forms of the branch next above it in organisation, but there is no *community of characters* between the two—each adheres to its own special type or plan. Thus, cephalopods may, in some points, be regarded as intermediate between mollusca and fishes, but the highest cephalopod is superior to the lowest fishes; nevertheless, as Von Baer remarks, "metamorphose a cephalopod as you will, there is no making a fish out of it, except by building up all the parts afresh." Darwin himself recognises this difficulty. Hence he says, in summing up, "I believe that all animals have descended from at most only *four* or *five* progenitors." But at this stage of his argument, the demands of his theory are imperative, and he adds—"Analogy would lead me one step further, namely, to the belief that all animals *and plants* have descended from some *one* prototype;" and arguing from what we must be excused from designating somewhat vague ideas of a *community of composition*, he adds this climax—"Therefore, I should infer from analogy that, probably, all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was first breathed."*

* Much stress has been laid, in derivative hypotheses, upon the changes which the organism undergoes in embryo; and, truly, it must diminish our feeling of incredulity in, and repugnance to, the theory of derivation, when we reflect on these changes. *A priori*, it does not seem more incredible that some adult species should have arrived at their present condition by having passed through inferior forms during immense periods of time, than that embryos should (as we know they do) pass through various representative forms of lower types of animal life, previous to arriving at their permanent condition. Embryology shows us

Let me now proceed to the examination of Agassiz' further arguments. I pass over his caustic remarks upon the confusion of ideas implied in the general term, *variability of species*; and I must also necessarily pass by his categorical contradiction of many of Darwin's fundamental statements; but never was a theory more sorely beset than is that of Darwin by the repeated assaults of such a giant in palæontology as Agassiz. Statement after statement, by which the whole theory hangs together, is assailed and impugned—stone after stone of the Darwinian structure trembles before the battering-ram of the champion of species. Out of twelve such reiterated attacks, ten of which are purely palæontological, and stand unchallenged, only one has called for remark, and that one, perhaps, the least important. Nevertheless, believing, as I do, that Agassiz has written no line without an object, I am bound to bring it before the tribunal of criticism. He says—"He (Darwin) would have us believe that animals acquire their instincts gradually, when even those that never see their parents, perform at birth the same acts, in the same way, as their progenitors." Now, this appears at first sight to be such a truism, that it seems unnecessary either for Agassiz to state it, or for me to defend it. But we must not forget that Agassiz writes with especial reference to an argument before us all, viz., Darwin's work on the "Origin of Species." We must, therefore, consider this passage relatively to that work. In chapter 8, we read—"If we suppose any habitual action to become inherited, then the resemblance between what originally was a habit, and an instinct, becomes so close as not to be distinguished;" and again—"Under changed conditions of life, it is at least possible that slight modifications of instinct

that there is no *natural barrier* to development, as long as that development is confined to cognizable gradations. But we have yet to learn that the embryo of a vertebrate animal ever exhibits the articulate or molluscan type; and the primary distinction thus implied casts doubt and difficulty upon the other cases in which the transition *seems* more easy and simple.

might be profitable to a species; and if it can be shown that instincts *do* vary, ever so little, then I can see no difficulty in natural selection preserving, and continually accumulating variations of instinct to any extent that may be profitable." Here, then, Darwin compares instinct to habit, and argues concerning it as he would argue concerning habit. But *instincts* exhibit themselves at the very threshold of life, before it is possible for *habit* to be developed, which presupposes some experience. Hence, how can we "believe (to use the words of Agassiz) that animals acquire their instincts gradually, when even those who never see their parents, perform at birth the same acts, in the same way, as their progenitors?" It will be seen, that in this connexion, the argument is not carping nor superfluous, but forcible and cumulative.

I now pass to a more important part of the subject, namely, the remarks of Agassiz in regard to the assumed connexion between *affinity* and *genealogical relationship;* and, in the first place, I cannot construe his observations in any way so as to make him argue that "similarity between adult animals is but an agreement in a single stage; and if agreement in a single stage be sufficient to prove genealogical relationship—then, since the embryos of very distinct animals are much alike, there must be a close relationship between these very distinct animals." What he *does* say is this—"There is nothing *parallel* between the relations of animals belonging to the same *genus* or the same *family,* and the relations between the *progeny of common ancestors.* In the latter case, we have the result of a physiological law regulating reproduction, and in the former, affinities, which no observation has thus far shown to be in any way connected with reproduction." Here we have an argument, in which the opponent challenges Darwin for *facts* in support of his hypothesis that *affinities* among animals are evidence of *genealo-*

gical relationship. He proceeds—"The most closely allied species of the same genus, *or* the different species of closely allied genera, *or* the different genera of one and the same natural family, embrace representatives which, *at some period or other of their growth*, resemble one another more closely than the nearest blood-relations; and yet we know that they are only *stages of development* of different species, distinct from one another at every period of their life." Here is not a word about similarity between *adult* animals, but the whole argument is based upon *developmental* changes, and the *reductio ad absurdum* is not proven. Thus, proceeds Agassiz, "The *embryo* of our common freshwater turtle (*Chrysemys picta*) and the *embryo* of our snapping turtle (*Chelydra serpentina*) [distinct genera, be it observed] resemble one another far more than the different *species* of Chrysemys [a single genus] in their *adult* state; and yet not a single fact can be adduced to show that any one egg of an animal ever produced an individual of any species but its own." A great and overwhelming fact against the theory of derivation, since it proves that the character of the species impressed upon the germ from the beginning, by hereditary descent, is dominant through all the various changes, analogies, and differentiations through which the embryo passes; never swerving from its undeviating course, except by the force of unwonted disturbing causes, and even then returning by the shortest cut to its original form; so that, as Agassiz elsewhere happily expresses it, "while *individuals* are perishable, they transmit, generation after generation, all that is specific or generic (or in one word *typical*) in them, to the exclusion of every *individual peculiarity*, which passes away with them." How different this from what Darwin's theory would demand of us, which tells us that it is just these *individual peculiarities* which are preserved, and, by their accumulation, *alter* the type.

But the head and front of Agassiz' offence lies in the

following illustration. He says—"A young snake resembles a young turtle, or a young bird, much more than any two species of snakes resemble one another, and yet they go on reproducing their kinds and nothing but their kinds; so that no degree of affinity, however close, can, in the present state of our science, be urged as exhibiting any evidence of community of descent." There is no man living who has more right to speak authoritatively on embryology, particularly upon that of the Reptilia, than Agassiz. For the first four years of *my* existence, *he* dwelt, as a disciple, in the house of Ignatius Döllinger, the master of the great Von Baer, and of Pander, and the father of the science of embryology. His laborious and marvellous work on the "Embryology of the Turtle" (Boston, 1857), which forms a portion of the "Contributions to the Fauna of the United States," is a monument of science and industry, of which any nation may justly be proud. No author has more completely, more thoroughly, or more exhaustingly investigated this difficult branch of physiology than Agassiz; and his assertions on this subject are entitled to the very highest respect. It is conceded that when Agassiz writes of a *young* snake and a *young* bird, in this passage, he refers to an embryo snake and an embryo bird, and, indeed, to a *young* embryo. I can only, however, bring the authority of other eminent physiologists to corroborate the assertion of Agassiz, which, *to non-physiologists*, no doubt, appears somewhat startling. I quote the following passage, therefore, from "Carpenter's Comparative Physiology," p. 628—"All the most important parts of the apparatus of organic life, and even the fundamental portions of that of animal life, are developed upon the same general plan in all vertebrata; and the *special* peculiarities of each class only *gradually* evolve themselves. The conditions under which the alimentary canal, the heart and blood-vessels, the liver, the corpora Woolfiana, the vertebral column, the nervou

centres, and the eye and ear, first present themselves, exhibit no essential difference in the fish, reptile, bird, or mammal." Again, "the history of development," says Von Baer, "is the history of a gradually increasing differentiation of that which was at first homogeneous." The fundamental type, he elsewhere explains, is first developed, and afterwards more and more subordinate characters appear. In these passages is stated, then, the fact, well known to physiologists, which Agassiz has summed up and illustrated in the line in question.

But is the objector and doubter aware that Darwin himself mentions this very fact, quoting Agassiz as an authority. At p. 439 of the "Origin of Species," we read—"It has already been casually remarked that certain organs in the individual, which, when mature, become widely different, and serve for different purposes, are in the embryo exactly alike. The embryos, also, of distinct animals, *within the same class*, are often strikingly similar; a better proof of this cannot be given than *a circumstance mentioned by Agassiz, namely, that having forgotten to ticket the embryo of some vertebrate animal, he cannot now tell whether it be that of a mammal, bird, or reptile.*" Not, however, that this is anything new—for, a dozen years ago, Agassiz wrote—"To deny the reality of natural groups because of their early resemblances would be to take the resemblance for the reality. It would be the same as saying that the frog and the fish are identical, *because at one stage of embryonic life, it is impossible, with the means at our command, to distinguish them.*" And again, in another place—"Hence, the embryos of different animals resemble each other more strongly when examined in the earlier stages of their growth. We have already stated that during almost the whole period of embryonic life, the young fish and the young frog scarcely differ at all; *so it is also with the young snake compared with the embryo bird.*" The truth is, that at a certain period, the embryo of a snake and the embryo of a

bird *are* as much alike as the embryos of two snakes, and affinity *is* thus at fault in indicating relationship, which is, in fact, the argument of Agassiz, and one which cannot be gainsaid.. This being the major proposition, the minor is, of course, included in it, namely, the assertion of Agassiz that "an *embryo snake* resembles an *embryo bird*, more than two *adult snakes* (of different species) resemble one another." The differences between embryos should undoubtedly be compared among themselves; but, nevertheless, if such differences are inappreciable in comparison with the distinct specific differences observed in adults, there can be no reason why the argument should not be strengthened by such a comparison.

There is yet one more portion of the paper of M. Agassiz, in which he has, as I conceive, been seriously misunderstood; and, it is a point not inferior in importance to any of those upon which I have already touched. Returning to the subject of *individuality* among Acalephs, with which he commenced the paper, he proceeds to specify the very remarkable modifications which the great "mystery of organic life" exhibits. First, he describes *hereditary individuality* as exhibited in all the higher animals. This is rare in Acalephs, and only exists in the Ciliogrades and some Pulmograde Discophoræ. Second, *derivative,* or *consecutive individuality,* such as occurs in the Nudibranchiata, which, from a single egg, produce more than one individual; this also occurs in such Medusæ as have what is termed an *alternation of generations.* Thirdly, *secondary indviduality,* such as is inherent to those individuals arising as *buds* from other individuals, and remaining connected with them (as in the fixed Polyparia); and, fourthly, *complex individuality,* in which such a community acts as a single individual, while each individual member may perform distinct acts of its own. This last occurs as a character of the Siphonophoræ among Acalephs—the Physogrades of De Blainville.

There is thus among Acalephs, great diversity of indivi-

duality; and, moreover, a similar diversity is observed in the specific differences among them; or, in other words, a greater or less degree of polymorphism is remarked. With Ctenophoræ (or Ciliogrades of De Blainville) this polymorphic tendency is at a minimum; for here, not only are the individuals composing the group closely similar, but being all hermaphrodite, there is not even the polymorphism arising from difference of sex. *This*, however, *does* occur in the Pulmograde Discophoræ (to which our naked-eyed Medusæ belong), and sometimes the variations are very striking, as in Aurelia, one of the covered-eyed division, which has received from writers the names, Aurelia lineolata (Peron), A. radiolata (Lamarck) A. granulata, A. rosea, A. surirea, A. purpurata, Medusa purpurata (Penn), and Biblis Aquitaniæ (Lesson), the species indicated being in every case *Aurelia aurita* (Forbes). Deviations from the normal number of parts constitute another source of polymorphism. Next, the cycle of individual differences embraces two distinct types of individuals—the *Medusa* type and the *Hydra* type. *One* of these types may exhibit more or less diversity, there being frequently *two* kinds of Hydra united in one and the same community; or (though more rarely), two kinds of Medusæ, as among the Siphonophoræ (Physogrades). Thus, in the Diphydæ, which appear like pieces of transparent glass, and which were imagined by Cuvier and others to consist each of two distinct animals, always united, although separable with impunity, Professor Huxley shewed (Phil. Trans., 1849) that they consist of two constantly associated, though easily separated forms, slightly attached, but capable, for some time at least, of an independent existence. These two Medusa forms, one (anterior natatory body) including the other (posterior natatory body), may be very similar, as in Diphyes, or very dissimilar, as in Cuboides vitreus. In the latter, the including (anterior) individual is large and cuboid, the included (posterior) individual is small,

tetragonal, and campanulate; whereas in Abyla trigona, the reverse occurs, the including individual being here small, subcuboid, and campanulate; and the included, much larger, oblong, and polygonal.*

Agassiz goes on to argue from all this, as follows—"But notwithstanding the polymorphism among the individuals of one and the same community, genetically connected together, each successive generation reproduces the same kinds of heterogeneous individuals, and *nothing but* individuals linked together in the same way. Surely we have here a much greater diversity of individuals, born one from the other, than is exhibited by the most diversified breeds of our domesticated animals; and yet all these heterogeneous individuals remain true to their species, in one case as in the other, and do not afford the slightest evidence of a transmutation of species."

It is immediately after this that the passage follows, the objection to which has given rise to these remarks—"Would," says Agassiz, "the supporters of the fanciful theories, lately propounded, only extend their studies a little beyond the range of domesticated animals—would they investigate the alternate generations of the Acalephs—the extraordinary modes of development of the Helminth—the reproduction of the Salpæ, &c.,—they would soon learn that there are in the world far more astonishing phenomena, strictly circumscribed between the natural limits of unvarying species, than the slight differences produced by the intervention of man among domesticated animals, and, perhaps, cease to be so confident

* In Prof. Huxley's elaborate Monograph of the Oceanic Hydrozoa (Ray Society, 1859) the Cirrhigrada and Physograda of De Blainville are recast and differently arranged, forming the two families, Calycophoridæ and Physophoridæ. The including and included individuals spoken of in the text are regarded by him as organs of propulsion, and distinguished as proximal and distal nectocalyx. I have retained Cuboides as an illustration, because it does not appear that this is interfered with by Huxley's supposition that it is a Diphyozoöid, derived from Abyla. In Hippopodius, a genus of the Calycophoridæ, the nectocalyces are said to be as many as twelve in number.

as they seem to be, that these differences are trustworthy indications of the variability of species."

I have here fairly stated Agassiz' views—in fact quoted them nearly verbatim, simply adding illustrations; and, I need scarcely remark, in the first place, that these "astonishing phenomena" can, in no respect, be imagined to be *novelties* to M. Agassiz, who, thirteen years ago, published, in conjunction with A. A. Gould, the admirable "Outlines of Comparative Physiology," in which a chapter is devoted to a lucid exposition of these very changes. In the second place, that in Darwin's work on the "Origin of Species," the subject of the "alternate generations of Acalephs, the extraordinary modes of development of the Helminth, and the reproduction of the Salpæ," are altogether ignored, and find no place in the argument, being nowhere, in the remotest manner, alluded to. From this I deduce *three* things:—First, that no man had more cause than Agassiz, by reason of his thorough acquaintance with the subject in all its bearings, to be impressed with the vast importance of these polymorphisms and alternations in any question of biology so comprehensive as the Origin of Species. Secondly, I think we have every right to infer that these most curious and astonishing phenomena (notwithstanding the elaborate notice which he takes of the somewhat analogous phenomena of *neuter insects*) had not been regarded by Darwin in so important a light as to make him consider them a necessary part of his argument, or a possible objection to his theory; and, thirdly, that Agassiz, whose opinion on the question must command the highest respect, by calling attention to the omission, has done nothing more nor less than might reasonably have been looked for from so distinguished a Physiologist.

But I still maintain that the object of the whole reasoning of Agassiz in the passage quoted is simply to draw the reader's attention to the fact of the great extent to which polymorphism

obtains among Acalephs, and that he nowhere states that he regards the metamorphoses undergone by them in the alternations of generations, in the light of *varieties*. He simply includes, and very properly, the cycle of ovum, hydroid, and medusoid, in *one polymorphic species;* and the illustration is, therefore, perfectly just.

But if Agassiz *had* definitely stated his opinion that the transformations of the Medusæ could be regarded as varieties, his doctrine would not have been so heretical but that he would have received the support of many eminent physiologists, and among them of the late illustrious Professor E. Forbes, than whom few had more closely studied the Acalephæ, as his beautful Monograph, published by the Ray Society, amply testifies. At page 82 of that work, he says—"In what light are we to regard the relationship between the Medusa and Polyp? The one is *not the larva* of the other, as is often improperly said, because there is *no metamorphosis* of the one into the other. The first is the parent of the last, and the last of the first, but neither is a *stage* of an *individual* existence, destined to begin life as a Medusa and end it as a Poloyp, and *vicé versâ.*

In the case of Aurelia—

a. The Medusa produces eggs;
b. The eggs produce Infusoria;
c. The Infusoria fix, and become hydroid Polyps;
d. The hydroid Polyps produce Medusæ by gemmation.

With such facts, unquestioned facts, before us, it seems to me that we have no choice between theories, and we must admit the idea of *alternation of generations* to be true."

In point of fact, however, the phenomena of alternate generations, or "the production of dissimilar individuals among sexual animals, by a non-sexual process" (Allen Thomson) are far more astonishing than the transformations undergone by insects. For there is only the most superficial analogy between

the *alternation of generations* of Medusæ and Salpæ, and the *metamorphoses* of insects. In the latter there is a distinct change from one stage into another, readily traceable; in the former, the animals "remain different through their whole life, so that their relationship does not appear until a succeeding generation. The son does not resemble the father, but the grandfather; and in some cases the resemblance reappears only at the fourth or fifth generation (as in Distoma) or even later" (as in Aphis, at the ninth.) Thus in the case of the Acalephs—the little animal, which on leaving the egg, has the form of an infusory, passes in succession through the phases of Scyphistoma, Strobila and Ephyræ, so called, because, before these changes were understood, they were imagined to be different *genera*, and were named accordingly. "But the remarkable point in these metamorphoses is, that what was at first a single individual, is thus transformed by transverse division into a number of entirely distinct animals, which is not the case in ordinary metamorphoses. Moreover the upper segment [of the strobila] does not follow the others in their development. Its office seems to be accomplished as soon as the other segments begin to be independent; being intended merely to favour their development, by securing and preparing the substances necessary to their growth." Hence they are called Medusa polypiform *nurses*. "There is [then] this essential difference between the metamorphoses of the caterpillar, and alternate reproduction, that, in the former case, the same individual passes through all the phases of development; whereas, in the latter, the individual disappears, and makes way for another, which carries out what its predecessors had begun. It would give a correct idea of this difference to suppose that the tadpole, instead of being itself transformed into a frog, should die, having first brought forth young frogs; or that the chrysalis should, in the same way, produce young butterflies. In either case the young would still belong

to the same species, but the cycle of development, instead of being accomplished in a single individual, would involve two or more acts of generation."*

I must, however, bring the subject to a close; not for want of material, for it is almost inexhaustible, but because I have already exceeded the limits I had anticipated. I trust I have fulfilled my pledge of justifying the criticism of M. Agassiz from the charges which have been brought against it; and I believe I may safely leave the matter in the hands of those who have listened to my vindication.

At the conclusion of the paper, the PRESIDENT said he would not invite discussion at that late hour (10.5). He desired to express the great interest and pleasure which he was sure had been felt by all who had listened to the many instructive matters which had been brought before them in the paper which had just been read by Dr. Collingwood, who, nevertheless, he thought, had altogether failed in showing the injustice of his strictures on the criticism of M. Agassiz. He would confine his remarks to two points, and, after all that had been said, he considered the illustration of the embryo snake and the embryo bird was an appeal to ignorance and not to science; and that M. Agassiz' petulant and offensive assumption of want of information on the part of Mr. Darwin and his supporters, on a subject unquestionably familiar to them, justified his censure of M. Agassiz' review as unworthy of so distinguished a philosopher. He (the Rev. H. H. Higgins) was not a supporter of Mr. Darwin's theory, but he deeply regretted the uncandid manner in which it had been in many quarters attacked.

Dr. COLLINGWOOD observed that calling the similarities among embryos "an appeal to ignorance" was simply begging the question. He did not consider it necessary to repeat his arguments, but he would cheerfully abide by what he had written, and was quite content that it should stand as the record of his defence of Agassiz.

* The passages in inverted commas I have quoted from Dr. Wright's edition of Agassiz and Gould's "Outlines of Comparative Physiology," London, 1851. I have considered myself justified in doing this, for these reasons; first, because although a work of Agassiz himself, two other names are associated with his in it;—secondly, because the statements are the most succinct and definite I have been able to meet with;—and thirdly, because I believe they are still accepted as the correct and philosophical view of the subject of *alternation of generations.*

Dr. Edwards hoped the President would not leave the chair without affording him the opportunity of expressing the gratification he had received from Dr. Collingwood's able exposition of M. Agassiz' views, and he moved that the cordial thanks of the society be presented to him; for he felt sure that all present must have been pleased with the philosophical tone and highly instructive character of his paper, which, he considered, relieved M. Agassiz from the charge of wilful obscurity, and, at the same time, was exceedingly impartial on the general subject.

The Rev. C. H. Burton seconded the motion, and confessed that he could not agree with the President's remarks, for he considered that Dr. Collingwood had successfully justified M. Agassiz.

SIXTH ORDINARY MEETING.

Royal Institution, 7th January, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. David Anderson, of Egremont, was elected a member of the Society.

The President called attention to the magnificent illustrated works recently presented to the Royal Institution by the Emperor of the French, and the late King of Prussia, and which, having been handsomely bound, are now placed in the Library. Among the various works presented by the Emperor of the French was the beautiful one on the Catacombs of Rome; and the work of Lepsius on Egypt, from the late King of Prussia, was a very valuable addition. The town of Liverpool was indebted to Mr. T. C. Archer for these splendid donations.

The President also referred to Dr. Wallich's recently published "Notes on the Presence of Animal Life at Vast

Depths in the Sea," in which it is stated that in sounding not quite midway between Capes Farewell and Rockall, in 1,260 fathoms, a number of starfishes, belonging to the genus *Ophiocoma*, came up adherent to the lowest fifty fathoms of the deep sea line employed. Such facts as these were extremely interesting, because they are quite at variance with our existing ideas respecting the depth at which animal life can exist in the sea.

Mr. Richard Brooke, F.S.A., then read a paper on—

"The Progress of Art, Science, and useful Inventions, since the Middle Ages,"

in which he showed by an elaborate reference to the history of inventions, that most of our important and wonderful discoveries are of comparatively recent date.

SEVENTH ORDINARY MEETING.

Royal Institution, 21st January, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The Rev. J. Macnaught, M.A., and Mr. H. B. Roberts, were elected members of the Society.

Dr. Collingwood drew the attention of the meeting to the Reports of the Microscopical Section of the Literary and Philosophical Society of Manchester, in which it was stated that envelopes had been supplied by the society for distribution among captains of vessels to enable them to preserve soundings, and other similar materials, for microscopic examination; and, he further added, that directions for the

preservation of minute objects of natural history had been lately drawn up by Mr. William Weightman, with the object of calling the attention of captains to their collection under favourable circumstances.

The PRESIDENT referred to a lately published work by Professor Phillips, entitled "Life on the Earth, its Origin and Succession," which he strongly recommended to the notice of the members of the Society; and read a passage from it, which placed the difficulties of the developmental hypothesis in a very just and strong light.

Dr. COLLINGWOOD exhibited and remarked upon the valuable work just published by the Ray Society, on British Spiders, by Mr. John Blackwall. This work is copiously illustrated with beautifully coloured plates, and is the first of two volumes upon this hitherto neglected subject.

The Rev. J. ROBBERDS drew attention to a published paper by Mr. P. H. Holland, read before the Society of Arts, on the means of preventing coal-pit accidents, in which the writer urged the desirableness of compelling colliery-proprietors, by Act of Parliament, to insure the life of every miner employed, so as both to secure some provision for his family in case of accident, and also to make it the interest of the proprietors to enforce every known precaution against accidents, in order to reduce the rate of insurance. The writer calculated that an advance of only one penny per ton on the 66,900,000 tons of coal annually raised, would be sufficient to insure the life of every miner to the amount of £200.

The following paper was then read:—

OBSERVATIONS ON AURORA.

By DAVID WALKER, M.D., F.R.G.S., M.R.I.A., F.L.S.

(Late Surgeon and Naturalist to the "Fox" Arctic Exploring Expedition.)

In bringing before you to-night some remarks as to the appearance, formation, and cause of Aurora, I shall confine myself to that which appears in the northern hemisphere, and is thence designated Aurora Borealis. I feel inclined to suppose that some of my remarks will apply to the Aurora Australis, but do not wish to encumber myself with reference to a phenomenon which I have never witnessed.

An appearance so remarkable as the Aurora could not fail to attract the attention of early observers, and afford cause for much conjecture. About the earliest theory respecting the cause was, that it was produced by the refraction of the Solar rays; another was, that it was identical with the tails of comets; another, that it depended on a mixture of the atmospheres of the earth and sun; while others ascribed it to the effects of the magnetic fluid. But as the science of electricity became better known and more fully developed—when its luminous effects were shown—and especially when a resemblance was traced between the luminosity displayed by the passage of an electric current through a partially exhausted tube, and the appearance of Aurora, all previous hypotheses were set aside, and the theory of Eberhard and Cavendish was adopted. They supposed that Aurora is dependent on electricity, transmitted through regions where our atmosphere is in a very rarified state; at the same time, it was also considered to have some connection with the magnetic forces of

our earth. Since the laws of meteorology have become better known, and the practice of recording meteorological observations more widely extended, the appearance of Aurora has attracted more attention, especially in its connection with the local variations of the magnetic needle and the disturbances sometimes noticed in the atmospheric electrometers.

Such observations have proved the fact that the Auroral light has been simultaneously perceived over a very extended space; for instance, Auroras in 1831 and 1839 were noticed at the same time, not only in the northern hemisphere, but also in the southern. Tables of the comparative frequency of the appearance of Auroras in different places point out the arctic zone, however, as that in which these phenomena most frequently occur.

Electricians and astronomers have endeavoured to ascertain the height of the Aurora above the earth, especially by measuring the height of the arc of the Aurora at different places, but as their observations were taken from different points of view, probably, each observer saw his own particular arc, and the results are, therefore, discordant. Thus, of two observers who calculated the height of the Aurora in January, 1831, one made it 18 miles—the other, 96.

The ancients supposed the height of the Aurora to be very great—even beyond our atmosphere—but later observers reduced it to 75 miles; thus, Cavendish supposes its usual elevation to be about 71 miles above the earth, at which elevation the atmosphere must possess but $\frac{1}{15000}$th part of the density of that at the earth's surface. Still more modern observers think it does not rise above the region of the clouds; and Wrangel, Struve, Parry, Fisher, and others, ascribe to it a very inconsiderable height.

Very valuable observations have been made by different persons in Aberdeenshire, tending to prove that, at times, its height is not more than half a mile above the surface of the

earth. Parry, in January 7th, 1825, whilst watching the variations in the form of an Aurora, saw a ray of light dart down from it towards the earth, between himself and the land which was about 3,000 yards from him; this was also witnessed by two of the officers of the expedition. I believe I am correct in stating that many of the arctic observers believe the Aurora to attain a very inconsiderable elevation in high latitudes. Hood and Richardson observed the same Aurora from different places: to the one it appeared in the zenith, forming a confused mass of flashes and beams—to the other, at many miles distant, looking in the same direction as the first observer, it presented the aspect of a low illumined arch. Sir William Hooker informs me that while passing a night on the summit of Ben Nevis, he distinctly saw the Aurora hanging in the valley between a neighbouring elevation and that upon which he stood; also that, at another time, during a fall of snow upon a mountain side, he observed that the particles were distinctly luminous, the air giving evidence, at the same time, of the presence of much free electricity. General Sabine also tells me that he has seen the Aurora low down, and passed through it, as one would walk through a mist. On the nights of the 30th and 31st March, 1859, I noticed the Aurora between myself and the land. The patches of light could plainly be seen a few feet above the surface of the water in Bellot Straits, the opposite land being about 2½ or 3 miles distant; and I am confident that if that land had been sufficiently high, the greater number of the 24 Auroras seen during the winter of 1858-9 above the water space in Bellot Straits, if not all, would have been seen suspended at a low elevation above the water or ice. To give as accurate a description as possible of my own experiences of Aurora, I transcribe from my journal, verbatim, the following extracts, to show some of the data upon which my remarks are founded:—

"Nov. 9, 1857 11 p.m. I have just come down from deck,

where I saw one of the finest Auroras we have had as yet—it extended for about 90°, being about 7° above the horizon—of a colour changing from a pale yellow to pale green, with vertical streamers towards the zenith; it seemed to appear just above a misty or foggy bank, which gradually enlarged till it obscured the Aurora; there were no vibrations or oscillations, but at times the Aurora was broken up into detached pieces; it was from S. to W., and lasted for an hour and a quarter.

Nov. 23. A pale, yellow Aurora appeared this evening for about an hour in the N.W. horizon, with occasional streamers rising 6° to 7° towards the zenith; it was rather vacillating in its character whilst it was visible; it was situated between Saturn and Jupiter. Another very bright one has just appeared from N.W. to S.E.; it was by far the brightest yet seen, and of a pale green colour; it appeared generally in arcs about 10° above the horizon; these arcs seemed to be composed of centres of effulgence with light spreading from the sides, and streamers stretching 20° towards the zenith; at other times broken up into detached pieces like the glow discharge of the electrical machine, sometimes divided into three tiers of arcs, all having streamers.

Wednes. Dec. 16th. Going upon deck at 9 p.m., noticed a hazy luminosity all over the sky; about 9.15 the Aurora presented itself; it commenced in the S., and then passed in a horizontal band to E., from that it passed to N. and N.N.W.; *south* joining *north* by a band through the zenith; E. also joining N.N.W. by a similar band. Three or four times I noticed a distinct pulse passing from S.E. to E., and from E. to N.; at times the merry dancers appeared, but at no time was there a brilliant appearance, only a universal luminosity; bands and conglomerate masses prevailed, but a few arcs appeared towards and round the zenith; there was a little wind and the pulsations seemed to go contrary to it. The

stars which were studding the sky were perceptibly dimmed—*no* sounds were heard—the colour was from a very pale yellowish green to a pale pink; it remained apparent for abou 15 minutes, *after which the atmosphere was filled gradually by a mist;* the luminosity formed no definite shape, except the few arcs spoken of; they only had pink; temp.—14°, bar. 29° 80.

Thurs., Dec. 17th, at 6.30 p.m., observed a faint Aurora from S.S.E. to E.; nothing particular about it; died out about 7.15. At 10 p.m., observed a bright Aurora, extending from S. to N.N.E.; a low bank of fog, 5° above the horizon, formed the edge of an arc, about 1° broad; 2° above this, another arc was situated, about 4° broad; these changed into broad luminous clouds at times, and then, again, formed a thin, long, arc, extending continuously from S. to N.N.E., with streamers ascending 8° to 10° towards the zenith; the colour generally a yellowish green, but once it was quite reddish in the E.; at this point, the Aurora was most intense and constant. I again noticed the pulse wave; it oscillated from S.S.E. to E.; the "merry dancers" sometimes was the form assumed; once or twice there was an instantaneous intensity in the light of the whole mass, and as quick a relapse to the original. In the thick body of the Aurora the light was so intense as completely to hide the appearance of stars of the first magnitude—through the streamers the stars showing, although but dimly; it is still visible; (12 p.m.) since its appearance the wind has increased; temp.—21°. At 11 o'clock, I noticed a falling star of a very bright character; it descended from 35° above the horizon and below Saturn, towards the horizon, but, on approaching the Aurora, it was dimmed, and then completely obscured; when it came to the thick band it left a tail 2° behind it—it fell very slowly. No sounds were heard with the Aurora; those bands which did appear were as luminous as those of last night, but were more confined to one part of the sky.

(12 p.m.) Still continues, more concentrated, and a little brighter; dense streamers, longer and altogether higher above the horizon. (4 a.m.) The Aurora still brilliant, and in the same direction, but forming more of an arciform shape, and changing sometimes to a reddish hue. (9 a.m.) Still apparent, —now crosses the zenith—not in streamers, but more in shapeless patches of thin light, across the zenith from S.W. to W. and W.S.W.; also, from E. to N.W., a broad band about 70° above the horizon in E., very persistent against the blue black ground; the stars are visible through it. *Minute spicula of snow visible through the atmosphere.*

Friday, 18th. As the daylight increased, the Aurora became less visible, and at 10 a.m., it was not seen, but, in its place, thin, fleecy clouds appeared, just as if it had been the cloud which had been rendered luminous. Everything having been prepared, at 10.30 a.m., whilst the cloud still remained, I connected an electrometer with the copper chain in the observatory, when distinct separation of the gold leaves took place. At 6 p.m., an Aurora was visible from E. to W. and N.W. across the zenith; it was in the form of bands or streamers. I again tried the electrometer, and again perceived distinct divergence of the gold leaves; this Aurora disappeared about 7 p.m. Again, at 8.30, there was an Aurora, stretching from S.S.W. to S.S.E., in the form of a bent arch or horseshoe, the key being in the S.S.E. Again, the electrometer was connected, and a still greater divergence of the gold leaves than before was noticed; this might be accounted for by the greater luminosity of the Aurora. I tried paper, saturated with iodide of potassium, interposed between two platinum wires, connected with the chain and the water, but no decomposition took place, and no spot was obtained. (12 p.m.) This Aurora is still visible, but with no particular shape; it extends from S.S.W. by S. to N., and not only horizontally, but towards the zenith, scintillations appear; it is most luminous towards the

S., where, occasionally, a wave appears, not like a pulse, as was the case the last two nights, but as if the cloudy appearance had been connected in the S.S.E. with an electric machine which when turned caused a flash of light to proceed from S.S.E. to S. Thin streamers passing towards the zenith; the body of the light decidedly obscures the stars of all magnitudes behind it; temp.—23° 5′, bar. 29° 82.

March 2nd, 1858. At 10.30 p.m. Patches, arches, and streamers of Aurora from S.W. by S. to E. from the horizon to the zenith, at times very bright, and with an occasional appearance, as if it were driven by a wind from S.W. by S. to S.E.; not wave-like, nor pulse-like, but just as the wind would drive a column of smoke, still keeping its defined outline. It was not of a dense character, as the stars were but little dimmed.

Dec. 24th, 11 p.m. Strong, flashing Aurora all over the heavens, causing great disturbance of the magnetometer. (12 p.m.) There is now no Aurora, and the magnetometer is steady. At the height of the Aurora the magnet oscillated at least 15°, so that I had to take the mean.

Jan. 10th, 1859, 12 p.m. A fine night, with Aurora since 8 p.m., from N. to S., across the zenith, in strong bands, at times varying their position. Used the electrometer at 10 p.m. found it affected; at 11 p.m. the magnetometer was slightly oscillating.

Jan. 31st. Aurora this evening from 6 to 8—from S.E. to W.,—bands from near the horizon to the zenith—a most distinct divergence of the leaves of the electrometer showing the influence of the Aurora.

Feb. 19th. Aurora at 11 p.m.,—from S. to N.,—through zenith—magnetometer unsteady.

Feb. 26th, 11 to 12 p.m. Aurora from N. to S.,—through the zenith—affecting (somewhat) the magnetometer."

To sum up: More than half the number of the Auroras

noticed during the two winters of 1857-8, and 1858-9, were seen in the direction of an open water space where much evaporation was going on; these Auroras beginning to appear at various degrees above the horizon, over a fog bank. It will be noticed that some of them affected the electrometer and the magnetic needle, causing, in the former, marked and increased divergence of the gold leaves; and, in the latter, considerable oscillation and variation in its movements.

I now proceed to quote some of the more recent and generally accepted theories, and explain that which first suggested itself to me when in the arctic regions, and which subsequent observations have confirmed. I approach this point with diffidence, as my theory clashes with those of some of the most scientific men of the day; at the same time, having observed data to work upon, I cannot but attach some weight to the results of personal and careful study.

M. Biot's theory is, in substance, as follows:—That the luminous clouds of which the Aurora consists are composed of metallic particles, reduced to an extremely minute and subtle form. Such metallic clouds (if the expression may be permitted) will be conductors of electricity, more or less perfect, according to the greater or less proximity of their constituent particles. When such clouds arrange themselves in columnar forms, and connect strata of the atmosphere at different elevations, if such strata be unequally charged with electricity, the electrical equilibrium will be re-established through the intervention of the metallic columns, and light and sound will be evolved in proportion to the imperfect conductibility of the metallic clouds, arising from the extremely rarified state of the fine dust or vapour of which they are constituted. If the metallic cloud possess the conducting power in a high degree the electric current may pass through it without the evolution of light or sound; and thus the magnetic needle may be affected as it would be by

an Aurora, though none be visible. If any cause alter the conductibility of those columnar clouds, suddenly or gradually, a sudden or gradual change would follow in the splendour of the Aurora.

M. Becquerel objects to this theory, that the existence of metal in that uncombined form—in which alone it has the conducting power—in volcanic eruptions, is not yet proved.

It should be said that M. Biot supposed the electricity to proceed from polar volcanoes.

Professor Faraday, in vol. 1 of his "Researches," remarks —"I hardly dare venture, even in the most hypothetical form, to ask whether the Aurora Borealis and Australis may not be the discharge of electricity thus urged towards the poles of the earth, from whence it is endeavouring to return by natural and appointed means above the earth to the equatorial regions."

Humboldt says—"The Aurora Borealis has not been described merely as an external cause of a disturbance in the equilibrium of the distribution of terrestrial magnetism, but rather as an increased manifestation of telluric activity, amounting even to a luminous phenomenon, exhibited on the one hand by the restless oscillation of the needle, and on the other, by the polar luminosity of the heavens. The polar light appears, in accordance with this view, to be a kind of silent discharge or shock, at the termination of a magnetic storm, very much in the same manner as in the electric shock, the disturbed equilibrium of the electricity is renewed by a development of light by lightning, accompanied by pealing thunder."

M. de la Rive, after speaking of the two electricities of the earth and atmosphere, and the recomposition going on between them, and stating that the great electrical discharge takes place at the poles, proceeds—"This discharge, when it has a certain degree of intensity, will be luminous, especially if—as

is nearly always the case near the poles, and in the higher regions of the atmosphere—it meet on its way those extremely attenuated frozen particles out of which the loftier clouds and mists are formed."

The following remarks embody my ideas on this subject:—

In the arctic seas there is always more or less evaporation from the surface of the exposed water, and, according to the time of year, the area of exposed sea surface will be great or small. Towards the end of August and beginning of September, as the sun's altitude decreases, the nights become gradually colder, the surface of the sea is frozen over, and the difference between the temperature of the air and the water increases. [For my purpose I shall speak of the sea of Baffin's Bay and Davis' Strait.] As the season advances, the evaporation which in summer appears as fog and mist, in winter takes the form of what is called "frost smoke"—that is—wherever a space of water appears, and the temperature of the air is colder than the water, the vapour of the water, in rising from its surface, becomes visible as a dense mist over that place, and is termed "frost smoke," or "water blink." At the south of Greenland, where the ice of Davis' Strait edges upon the waters of the Atlantic, a greater number of Auroras is seen than in any other place along that coast line. The mass of ice filling up Davis' Strait and Baffin's Bay is broken up by winds, tides, and currents, and spaces of water appear among the fields of ice; these spaces are recognised through the winter by the "frost smoke" rising from them. The air in the neighbourhood of these seas, is always loaded with extremely minute spicula of snow. Many of the Auroras noticed were in the direction of the open spaces of water seen during the day, such spaces being, as usual, marked by the "frost smoke." I believe these Auroras were connected with the vapour arising from the open spaces of water, and that they were caused by the condensation and subsequent freezing of the particles of

vapour; such particles evolving positive electricity, and by induction from the surrounding atmosphere, producing a light, transmitted from particle to particle, thus rendering the whole mass of vapour luminous, the lower edges of the arch of the Aurora being the place where this condensation and congelation first takes place. As the cold increases, the number and intensity of Auroras, seen at any place on the Greenland coast, are proportionate to the proximity of the edge of the ice to that place.

Early in the winter, at the northern ports of Greenland, the Aurora is seen indefinitely—higher up in the sky, and nearer the zenith, than at a later period of the year—when, after the sea has been, to a great extent, covered over with ice, the Aurora locates itself towards the open water spaces. In reading Dr. Kane's account of his last expedition, I was struck with the fact that Auroras were scarcely ever seen during his stay at Rensselaer harbour, the first having been noticed some 15 months after his arrival there. I account for this by the absence of open water in his neighbourhood, and to me it is an additional proof of the non-existence of a *polar basin*. As a rule, Auroras increase in brilliancy as they approach the zone of the line of winter ice.

During the homeward voyage of the "Fox," across the Atlantic, in September, 1859, I had the opportunity of seeing several Auroras, which at times assumed the appearance of cirrhous clouds; at other times they presented the usual luminous Auroral aspect; many times since I have noticed the same appearance. I am of opinion that the Auroras seen in our latitudes, and across the zenith in the arctic regions, are produced by the same cause as those just described near the horizon.

Whenever the temperature of a cloud, charged with particles of vapour, is lowered—either by changing its position, or by the access of a colder atmosphere—and the particles become

frozen—evolving positive electricity, and, by induction, causing a luminosity; such clouds, meeting with others charged with opposite electricity, would communicate by means of streamers, these also being luminous. These appearances will present themselves wherever there are clouds composed of frozen particles, acted upon by the surrounding atmosphere, or by neighbouring clouds, so that *no* altitude will be too great, or too inconsiderable for the appearance of Aurora, so long as the atmosphere contains the necessary conditions for the evolution of this light. It will thus appear that the wind may cause a pulsation in the body of an Aurora, and even an increase in its brilliancy, the friction produced by it, perhaps causing an increase in the electricity.

In other words, a vapourous cloud, passing through a region where the air is of lower temperature, becomes condensed, and (if the temperature be sufficiently low) composed of minute frozen spicula, which induce recomposition between the negative clouds near them, causing streamers and bands to flash out light. I have often noticed in these streamers an appearance, as if the light were *sucked* up towards the zenith. I believe Aurora is never seen, except when these clouds, or other similar vapours, are exposed to the process of congelation.

The appearance of Auroras in the direction of, and over the places where open water spaces exist, and the connexion between cirrous clouds and Auroras, to me appear positive proofs of the truth of this "congelation" theory.

The two Auroras seen in Bellot Strait, between myself and the land, were apparently but a few feet above the surface of the water. The lower part of the vapour was comparatively transparent; above this was a fringed darker portion, then the auroral lights pervaded the remainder, not as a flash, which might have been an optical illusion, but steadily waving between my position and the land.

I shall now enumerate a few facts which seem to me to bear upon the subject. Dr. Richardson, near Bear Lake, saw the palpitations of the Aurora before the total disappearance of day-light: during the day he had seen the clouds arranged in arches and columns like the light of the Aurora. M. Lottin, in his description of the general appearance of the Aurora in the Bay of Alten, remarks "that after the first half of the night the Aurora seems to have lost its intensity, the pencils of rays, the bands and the fragments of bows appear and disappear at intervals; the rays become more and more diffused, and ultimately merge into the vague and feeble light which is spread over the heavens, grouped like little clouds and designated by the name of *auroral plates*. The phenomena became gradually more faint and disappeared altogether on the appearance of twilight; it often happens that as the daylight augments, the Aurora gradually becomes vague and undefined, takes a whitish colour, and is ultimately so mingled with the cirro-stratus clouds that it is impossible to distinguish it from them." Humboldt remarks, "The knowledge which we at present possess of the altitude of the polar light is based on measurements which from their nature, the constant oscillation of the phenomenon of light and the consequent uncertainty of the angle of parallax, are not deserving of much confidence. The results obtained, setting aside the older data, fluctuate between several miles and an elevation of 3000 or 4000 feet: and in all probability the northern lights at different times occur at different elevations. The most recent observers are disposed to place the phenomenon in the region of the clouds and not on the confines of the atmosphere: and they even believe that the rays of the Aurora may be affected by winds and currents of air, if the phenomenon of light (by which alone the existence of an electro-magnetic current is appreciable) be actually connected with material groups of vesicles of vapour in motion, or more correctly speaking if

light penetrate them, passing from one vesicle to another." Almost all observers, in speaking of the origin of an Aurora, remark that it rises above a fog-bank; I shall transcribe the words of M. Lottin—"Between the hours of four and eight o'clock in the afternoon a light sea fog, which almost constantly prevailed, extending to the altitude of 4° or 6° above the horizon, became coloured on its upper border, this border becomes gradually more regular and took the form of an arc of a pale yellow colour, &c." Gissler in his observations taken in Sweden states—"that on the high mountains the traveller is sometimes suddenly enveloped in a very transparent fog of a whitish grey colour passing slightly to green, which rises from the ground and is transformed into the Aurora Borealis." Humboldt again remarks "that the greatest absolute number of northern lights appears to occur towards the close of the months of September and March." Herr Rink in his remarks upon the Auroras of Greenland, states "that undoubtedly the Aurora is seen more frequently and in a more intense degree in South Greenland than in North Greenland, and he can decidedly affirm that the Aüroras at Julianehaab, 61° N. lat., were seen from three to four times longer than at Omenak, 71° N. lat., in North Greenland; almost every night in the winter Auroras were seen at Julianehaab." I have spoken of the two maximum periods of September and March, it will now appear evident why these should exhibit more auroral displays than any of the other winter months, on account of the conditions for the formation of such Auroras being more favourable, the open water spaces gradually increasing in extent, and the consequent greater amount of material for the formation of fog bank and cirrous clouds becoming eliminated. The non-appearance of lightning in the arctic regions is accounted for by the electricity being equilibrized by the congelation of the vapour.

I should much like to enter into the connection between

the Aurora and magnetism; also its relation to the "électricité dissimulée." Time, however, forbids more than a passing reference to the Auroral bands of Lottin, Humboldt, and others, which I conceive to have been simply cirrous clouds possessing electricity, and arranging themselves according to the laws of terrestial magnetism. The great difficulty of detecting the presence of atmospheric electricity in the northern regions has caused much enquiry; but we may see that the uncombined electricity will be proportionate to the paucity of Auroras; when its appearance is frequent, electric disturbances will be oftener shewn by the instruments. I have previously alluded to the effect of Aurora, not only on the gold leaf electrometer, but also on the magnetometer, which at one time vibrated 7½° either way. This explanation would go far to account for the more frequent appearance of Aurora in this country, the amount of cold having been greater during late winters.

It would be interesting to discuss the connection between magnetism and cold; we know that the poles of each are placed, if not together, at least near each other. But again, time prevents my indulging myself, especially as I know that another paper on a subject no less interesting to the majority of my listeners than the present is to follow mine. In conversing lately with the Rev. Mr. Fisher, the Astronomer of Parry's Expedition, I find that he agrees with all the remarks I now make.

At the conclusion of the paper, the President having invited remarks and questions,

Mr. Towson observed that, while the general phenomena of aurora seemed sufficiently accounted for by Dr. Walker's theory, one phase of it was not fully explained, namely, the sudden springing up of the auroral light from the horizon to the zenith, and its rapid attraction

to the horizon. Could it be possible that icy particles could be so instantaneously formed?

Dr. Edwards remarked that his experimental illustrations showed that the nature of the discharge differed according to the degree of condensation of the atmosphere. The nature of the discharge in the higher regions of the atmosphere must, therefore, depend on the altitude. He could not conceive that icy particles should exist in such quantities at so great an elevation above the earth as that at which the auroral discharge took place. He had been led, from experiment, to believe that the auroral discharge was always associated with great tenuity of atmosphere, the best imitations of the phenomena occurring when the gaseous atmosphere would support from one-eighth to one-sixteenth of an inch of the mercurial column. He believed, therefore, that the appearance described by Dr. Walker, of the auroral light descending to the surface of the earth, was an optical illusion, of the nature of a mirage.

Dr. Collingwood thought that inasmuch as Dr. Edwards' experiments were for the most part made in artificial atmospheres, differing very materially from the aerial atmosphere, no positive conclusion could be drawn from what might be an accidental resemblance to the phenomena of aurora; or, at all events, no argument could be supported by those experiments against carefully observed facts, such as Dr. Walker had described.

Dr. Edwards explained that the Torricellian vacuum gave as good a result as any artificial atmosphere.

Mr. Robberds remarked that Dalton had called attention to the fact that aurora was usually unaccompanied by clouds, being, in fact above the region of clouds.

Mr. Higginson said it should always be recollected that a constant evaporation was taking place from ice.

The President believed that aurora was generally associated with clouds, which obstinately appeared to conceal the most brilliant parts. He thought it probable that the same observation would not suffice to explain all the phenomena, and inquired whether Dr. Walker had ever heard any sounds connected with the aurora?

Dr. Walker replied that there was no doubt that the sounds alluded to were caused by some movements in the different strata of ice, dependent upon their unequal contraction and expansion, and Humboldt had remarked that those only heard such sounds who listened for

them. He also dwelt upon the fact of the auroral light having been seen by himself and others, for some time, hanging between two points of land. In answer to a question from Dr. Collingwood, he stated that the dark bands were certainly not the result of mere contrast with the brighter parts.

EIGHTH ORDINARY MEETING.

ROYAL INSTITUTION, 21st January, 1861.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

The Rev. H. J. HINDLEY, M.A., and the Rev. C. D. GINSBURG, were elected members of the Society.

Mr. FABERT exhibited a remarkably fine specimen of red coral (*Tubipora musica*) from the Chinese seas, and several other objects of interest.

The Rev. J. ROBBERDS drew attention to Mr. P. H. Holland's method of sealing safety-lamps, so that they could not be opened without detection. The plan was similar to that of the metallic fastenings formerly applied to envelopes.

Dr. COLLINGWOOD exhibited some of the microscopic collecting envelopes referred to at the last meeting.

The PRESIDENT drew attention to the contemplated anniversary festival of the Liverpool Naturalists' Field Club, to be held in St. George's Hall, in April next, and read a prospectus of the proposed plan. He invited the assistance of ladies and gentlemen interested in the subject.

The following paper was then read:—

CONTRIBUTIONS TO NAUTICAL SCIENCE.

By THOMAS DOBSON, B.A., Cantab.

(Head Master of the School-frigate "Conway.")

When Newton was engaged in investigating the nature of the great mechanical laws that govern the material universe, he is said to have made use chiefly of the method of fluxions, the most efficient instrument of mathematical investigation known at that time; but he took care to clothe the results of his researches in a comparatively simple geometrical dress.

The wisdom of such a course will be appreciated by persons engaged in instruction, who have to communicate to others the knowledge of necessary truths at which the philosopher has already arrived only by a patient and skilful marshalling of his mathematical symbols; and this communication is only practicable with young students when the subject can be presented to them in an elementary form. The mathematician of our day employs in discovery the Differential and Integral Calculus, justly styled by Dr. Whewell, in his Philosophy of the Inductive Sciences, "the principal weapon by which the splendid triumphs of modern mathematics have been achieved." But the philosopher seldom condescends now to imitate the master of philosophy by announcing his discoveries to the world in such a simple form as to put them on a level with the capacity and attainments of all who may have an interest in understanding them. His is the noble ambition of discovering hidden truth, and he leaves to others the humble, but still useful and honourable, office of devising the best means of diffusing a knowledge of his discoveries. My daily avocations have led me to become a labourer in this humble sphere.

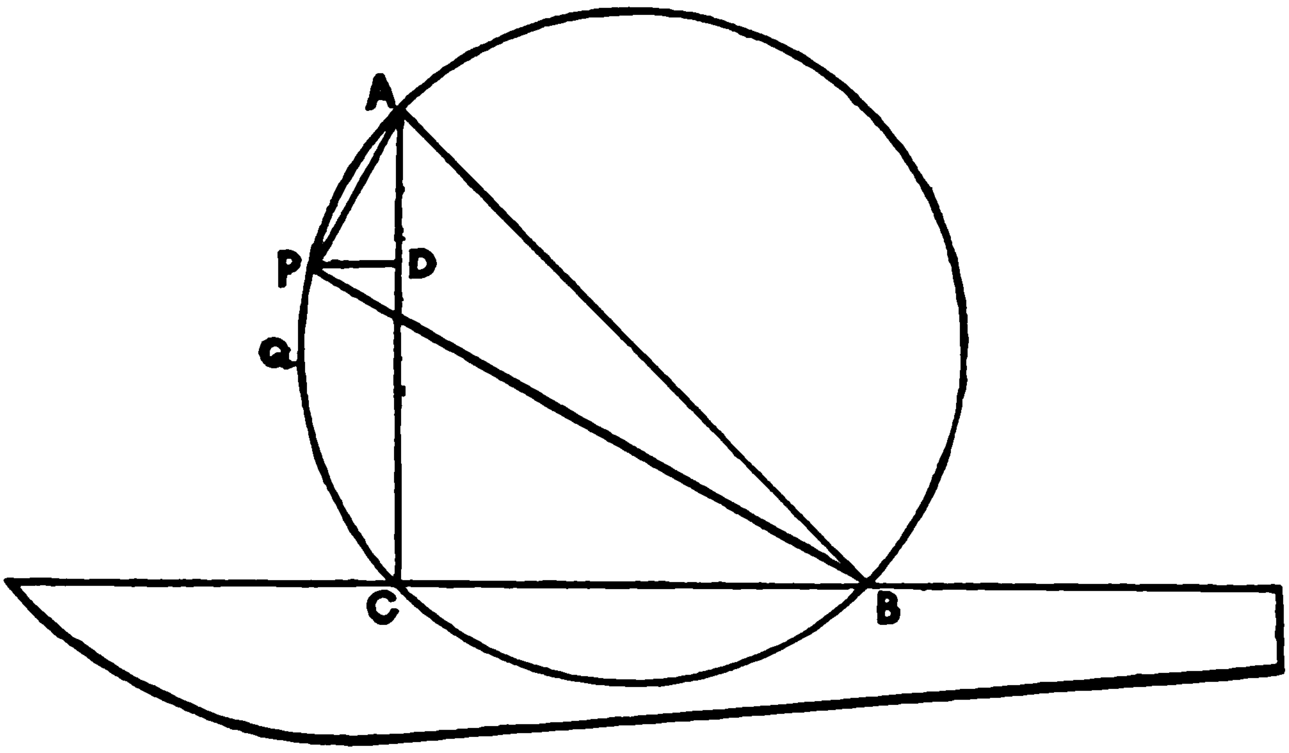
Of all men, the sailor is most indebted to the mathematician, who has framed the rules which the sailor practices and relies upon ; and computed the numerical data which the sailor takes from his Nautical Almanac ; data which embody the practical results of mathematical problems of the very highest order of difficulty, and which have taxed the powers of the greatest mathematicians from Newton's time to our own.

Nautical science, then, having thus been constructed by help of the higher mathematics, offers an ample field for simplification ; and that such a process is most desirable will be obvious when we reflect how essential a clear knowledge both of the principles and practice of nautical science is to that numerous and valuable body of men who are responsible for all the lives and property afloat. Such knowledge is more than ever indispensable in these days of steamships, clippers, and rapid passages, when a merchant captain must strain every nerve—and what is much worse, run every risk—in order to satisfy an exacting public, by making a passage in the shortest possible time. It is evident that the danger from an error in the reckoning of a dull sailing vessel is much less than in that of a long, sharp clipper; on the principle that the further you go on the wrong road, the more you go wrong.

The first subject to which I shall ask your attention this evening is a question relating to practical navigation, and may be enunciated thus :—

"The direction of the wind, and the course of the ship, being known, required the direction of the sails, so that the ship may make the most headway." This problem belongs to the difficult class of "maxima and minima," which are most successfully attacked by means of the Differential Calculus, and thus I first accomplished its solution. But, anxious to bring it within the reach of my pupils, I reconsidered it, and first succeeded in solving it by means of plane trigonometry; but at last was rewarded by discovering the simple geometrical

proof which follows. I am not aware that this problem has been published in any form; it is certainly not mentioned in any of the numerous English and foreign works on navigation that I have consulted.



Let A B be the direction of the wind, B C the direction in which the ship is progressing, and B P the projection of a sail on the plane of the deck. Draw A P perpendicular to B P, A C perpendicular to B C, and P D perpendicular to A C. Then, if A B represent the force of the wind, A P will be the effective part of it, acting perpendicular to the sail, and P B the non-effective part, acting parallel to the sail.

Now, A P is equivalent in magnitude and direction to the two component forces A D and D P, of which A D perpendicular to B C produces leeway only; and D P parallel to B C produces headway only.

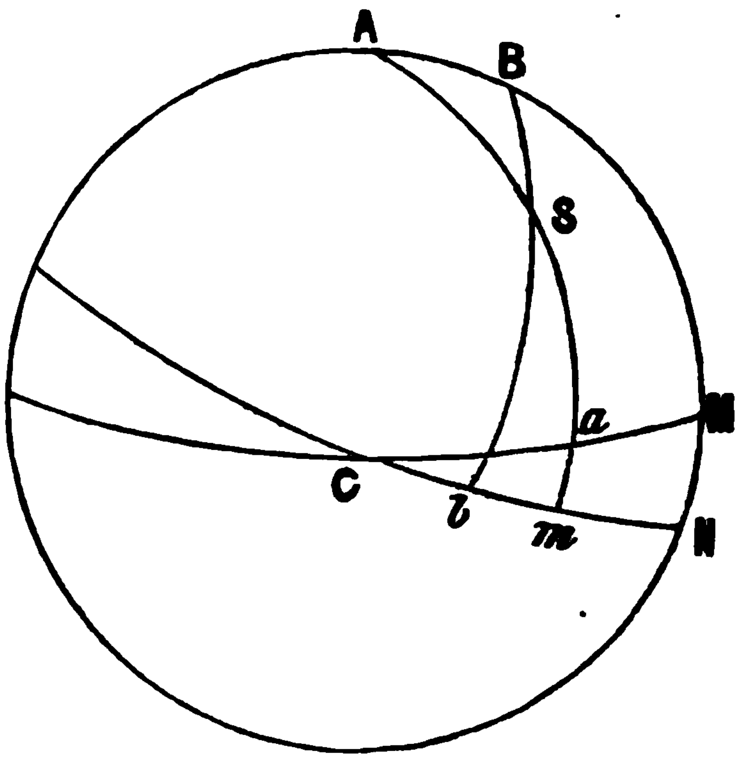
Since A P B and A C B are right angles, the points P and C lie in the circumference of a circle of which A B is the diameter; and P D is the perpendicular from a point in the arc A C on its chord A D C; and will obviously be greatest when P coincides with Q, the middle point of the arc A C. Hence, in order to make the most headway, the ship's sails and yards should, as nearly as the shrouds, &c., will allow, lie

midway between the ship's course and the direction of the wind.

In some of the most important practical applications of nautical astronomy, where two altitudes of a heavenly body are taken at an interval of a few hours, during which the vessel has been proceeding on her course, it is necessary to reduce the first altitude to what it would have been if it had been measured at the place where the ship is when the second observation is made.

My second contribution to nautical science is a simple elementary investigation of the value of the correction to be applied to the first altitude to compensate for the "run" of the ship, as it is called. This value, of course, is well known, but my proof is well adapted for instruction, inasmuch as it has the advantage of placing clearly before the student the things which he is required to reason about, and is made to depend upon the rule for parallel sailing—the simplest case in spherical trigonometry. In this case, as in several others, I had the alternative of either inventing a simple intelligible proof, or of giving the rule to my pupils without demonstration, and resting on authority alone; a mode of proceeding altogether inconsistent with sound teaching.

Let S be the sun's position when the ship's zenith is A; S*a* the sun's altitude above the horizon C M of A; S*b* his altitude above the horizon C N of B; where B is the zenith of the ship at the time of the second observation.



Let A B = d = M N, the distance run between the two observations;

$$Sa = a\,;\ \text{and} < S\,A\,B = A.$$

Since Sm is sensibly equal to Sb, the correction to be added to Sa in order to make it equal to Sb is $a\,m$. Now < C is small, and $Ca = Cm$ very nearly, therefore $a\,m$ will not differ sensibly from the arc of a small circle of the sphere described with centre C, and passing through a and m.

$$\text{Hence, } a\,m = M\,N \cos. a\,M = d \cos. A.$$

$$\therefore \quad Sb = a + d \cos. A.$$

If < A is greater than a right angle, the figure will give

$$Sb = a - d \cos. A.$$

The following paper was also read:—

NOTES AND EMENDATIONS TO SHAKSPERE'S "MERCHANT OF VENICE."

By WM. IHNE, Ph.D., *V.P.*

I.

I., i., 29, 4.*

"To find the other forth, and by adventuring both."

Verses of six feet, like this, are indeed frequent enough in Shakspere; but, unless I am much mistaken, some of them owe their origin to the early editors, and not to the poet. The present verse would assume the usual length by throwing out two useless syllables. It would then read—

"To find the other forth, and venturing both."

II., i., 1, 11—

"*Morocco.* I would not change this hue,
Except to steal your *thoughts*, my gentle queen."

* As the scenes in Shakspere are too long to serve the purposes of easy and expeditious reference, the author has numbered the speeches in each scene, and, in long speeches, even the lines. Thus I., 1, 29, 4, means first act, first scene, twenty-ninth speech, being *Bassanio's*, and beginning, "*In my school days;*" and, of this speech, the fourth line.

The word *thought*, which now we refer exclusively to an operation of the intellectual faculties, is in this passage, and frequently by Shakspere, used as synonymous with "feeling," or "heart." Thus it is clearly employed, II, vi., 11, where *Jessica* expresses a doubt if she is really *Lorenzo's*, and *Lorenzo* replies—

> "Heaven and thy *thoughts* are witness that thou art."

And III., ii., 12—

> "*Portia*. How all the other passions fleet to air,
> As doubtful *thoughts* and rash-embraced despair,
> And shuddering fear, and green-eyed jealousy!"

Here we find "thoughts" classed as a passion, with despair, fear, and jealousy.

III., iv., 5—

> "Fair *thoughts* and happy hours attend on you."

This is *Lorenzo's* wish at parting, and it expresses clearly very much the same that *Jessica* adds—

> "I wish your ladyship all heart's content."

Compare "Julius Cæsar," III., i., 67—

> "With all kind love, good *thoughts* and reverence."

II.

II., ix., 3, 6—

> "If I do fail in fortune of my choice."

I think we have here a misprint, perpetuated through all editions, for

> "If I do fail *of* fortune *in* my choice."

Arragon had just said—"If I fail *of* the right casket." The sense becomes much clearer by the proposed alteration.

III.

III., i., 3—

> "*Salanio*. I would she were as lying a gossip in that as ever knapp'd ginger, *or* made her neighbours believe she wept for the death of a third husband."

The knapping of ginger and the fictitious tears must clearly be taken together as proving the woman in question to be a lying gossip, for, surely, the knapping of ginger alone is not a proof of lying. We must, therefore, read, "as ever knapp'd ginger, *and*, &c." *Salanio* alludes to a widow that made her tears flow by the application of ginger, and then pretended she was weeping tears of sorrow.

IV.

III., ii., 10—

"Tell me where is fancy bred,
Or in the heart, or in the head,
How begot, how nourished?
Reply, reply.

Is it engendered in the eyes,
With gazing fed, and fancy dies
In the cradle, where it lies?
Let us all ring fancy's knell;
I'll begin it: Ding, dong bell."

The meaning of this little poem has been entirely hidden and perverted by Steevens' explanation, which appears to have been accepted by all subsequent editors, by Schlegel, in his admirable translation, and by readers in general. Steevens explains "fancy" to mean "love," and appends a passage from the "Midsummer Night's Dream," where fancy clearly has that meaning—

"Sighs and tears, poor fancy's followers."

Many more passages might be adduced to show that "fancy" is used as a synonym of "love;" but the question is, whether that meaning applies here. When we examine the poem, we find that it is not a love song, but a dirge—

"Let us all ring fancy's knell."

What could be more inappropriate or of worse omen than

to sing the death-song of love at the very moment when love is to be triumphant, and about to unite two loving hearts together. We must suppose the musical accompaniment to have been under the direction of *Portia*. But it harmonizes very badly with that lady's good sense that she should be guilty of such a blunder. Besides, is it really true, by all the experience of lovers, or is it a theory held by Shakspere, that "love is engendered in the eyes?" Surely it is not, but, as *Helena* expresses it in the "Midsummer Night's Dream," I., i., 49—

> "Love looks not with the eyes, but with the mind,
> And therefore is wing'd Cupid painted blind."

We must, therefore, on all grounds, condemn Steevens' explanation; and now arises the question, what is the right one? The poem must harmonize with, and have a bearing upon, the scene into which it is inserted. It is the scene in which *Bassanio* has to choose the right casket. His two predecessors had both failed, being misled by the glitter of the outward show to choose the golden and the silver caskets respectively, though the *Prince of Arragon*, like a "deliberate fool," had wisely remarked, that "the multitude choose by show, not learning more than the *fond* eye doth teach"—II., ix., 5. Now, *Bassanio* might have fallen into a similar error; but maturely reflecting on the fallacy of judging through the "fond" eye alone, and from external appearances, and, warned by the friendly admonition contained in the song, that the eye produces fancy, he comes to the conclusion—

> "So may the outward shows be least themselves,
> The world is still deceived with ornament," &c.

The train of ideas with which he begins is evidently but the continuation of those contained in the poem. And now we cannot have the least difficulty in recognising the true meaning

of "fancy." It is a contraction of "phantasy," with which "phantasma" and "phantom" are connected, and derived from the Greek, *φαίνειν*, "to show." It denotes that which is unreal, or only apparently real, a creation of the mind, and it is, therefore, used as opposed to truth and reality. Fancy pictures to itself things different from what they are—a fancy picture has always much of fiction in it; the fancy of men, therefore, leads them astray, it is not directed by judgment, and therefore often, as in our passage, equivalent to "illusion."

V.

III., ii., 14, 12—

> "An unlessoned girl, unschool'd, unpractised,
> Happy in this, she is not yet so old
> But she may learn; happier than this,
> She is not bred so dull, but she can learn;
> Happiest of all *is*, that her gentle spirit
> Commits itself to yours to be directed."

The correctness of this passage, as far as I can ascertain, has never been questioned; and yet, it undoubtedly contains a serious error. The three adjectives, "happy," "happier," "happiest," clearly refer to the substantive "girl," to which they form simple attributes. But this attributive connexion is destroyed by the verb "is" in the fifth line. This verb requires a subject to which it must be referred. If the grammatical laws of the language allowed us to supply the pronoun "she" the difficulty would be at once removed, at least as far as the syntax of the sentence is concerned; though the symmetry and regularity would still suffer. But that pronoun cannot be supplied, and therefore, the sentence, as it stands, is incorrect, and has been reprinted, in every edition of Shakspere, in bold defiance, or in happy ignorance, of good grammar. Let us do tardy justice to the poet, and by removing an ugly misprint, restore the genuine reading.

An unlessoned girl,
Happy in this, &c., happier than this, she is, &c.,
Happiest of all *in** that her gentle spirit
Commits itself to yours to be directed.

VI.

III., ii., 14, 20—

"But now I was the lord
Of this fair mansion, master of my servants,
Queen o'er myself; *and even now, but now*
This house, these servants, and this same myself,
Are yours."

Portia contrasts the immediate past with the present time. To the former period she refers by saying "but now," to the latter in the words "and even now, but now." Here, it is strange that the same expression, "but now," should be used in two senses entirely opposed to each other. That they can be used in this way there is no doubt. The "but" in the first expression would be used as an adverb, equivalent to "only," or "almost;" the "but" in the second would be a conjunction, equivalent to "however." We may say—

"But now the mighty Cæsar was a god;
But now he is a lifeless clod of earth."

It is, however, apparent that the adversative conjunction "but" cannot be employed unless it heads that portion of the sentence to which it belongs. It can in no way be preceded by the conjunction "and." Therefore, the words, "and even now, but now," cannot have the force of adversative particles. What, then, shall we do with them? How shall we explain them? I confess I see no remedy but an alteration of the text, and I take my cue from a passage in this identical play. We have a similar contrast of past and present in I., i., 4—

* When the author wrote this, he was not aware of the fact that Collier's annotator had proposed the same alteration. This was pointed out to him by Mr. Tinling, who also suggested a further very ingenious emendation, viz., to read (l. 3), "happier *in* this," for "happier *than* this."

> "And in a word, *but even now* worth this,
> And now worth nothing."

We see from this passage that, whereas "but even now" refers to the past, the present is indicated not by "but now," but by "and now." Let us apply what this passage teaches to the passage under consideration, and we shall find that by the simple transposition of "and" and "but" we shall restore sense and grammar, as the verse will then read—

> "Queen o'er myself, but even now;—and now
> This house, these servants, and this same myself,
> Are yours."

VII.

III., ii., 22—

"*Bassanio.* And do you, Gratiano, mean good faith?
Gratiano. Yes, faith, my lord.
Bassanio. Our feast shall be much honour'd in your marriage.
Gratiano. We'll play with them the first boy for a thousand ducats.
Nerissa. What, and stake down?
Gratiano. No; we shall ne'er win at that sport, and stake down.
But who comes here? Lorenzo and his infidel?
What? and my old Venetian friend, Salerio?"

As this passage is printed in our editions, it is really in a sad state. We have prose and verse jumbled together, and verses of all lengths. It is not difficult to restore it to perfect metre by a few slight alterations.

"*Bassanio.* And do you mean good faith?
Gratiano. Good faith, my lord.
Bassanio. Our feast shall be much honoured in your marriage
Gratiano. We'll play with 'em, the first boy a thousand ducats.
Nerissa. What, and stake down?
Gratiano. No; we shall never win
At that sport, and stake down. But who comes here?
Lorenzo and his infidel? What, and
My old Venetian friend, Salerio?"

The only alterations made are—1st. The omission of the

unnecessary word *Gratiano* in the first verse. 2nd. The spelling of "'em," for "them," by which the two words, "with them," can be contracted into one (as in "Julius Cæsar," I., ii., 38, 12). 3rd. The omission of "for," which also is superfluous.

VIII.

III., ii., 41—

> "The dearest friend to me, the kindest man,
> The best condition'd, and unwearied spirit,
> In doing *courtesies*; and one in whom
> The ancient Roman honour more appears,
> Than any that draws breath in Italy."

In this glowing description of the high and noble qualities of his friend *Antonio*, it is clear, that *Bassanio* does not take the word "courtesy" in the sense in which alone it is now current, and which makes it equivalent with civility and urbanity—things pertaining not to a man's morals, but rather to his manners. The meaning Shakspere attaches to the word is more honourable to Antonio; it is evidently used as synonymous with "kindness." This is borne out by another passage in the same play. III., i., 17—

> "He was wont to lend money for a Christian courtesy."

And by *Lear*, II., iv., 55—

> "O Regan, thou shalt never have my curse.
> Thou better know'st
> The offices of nature, bond of childhood,
> Effects of *courtesy*, dues of gratitude."

IX.

III., ii., 44, 5—

> "Should lose a hair through Bassanio's fault."

This verse lacks a syllable, which Symmons has supplied by reading—

> "Should lose a hair through *my* Bassanio's fault."

But there is no occasion to add a word. We need only spell and read "thorough" instead of "through," and the rhythm is unexceptionable.

X.

IV., i., 28—

"To cut the forfeiture from that bankrupt there."

This verse has one syllable too many; but Shakspere wrote—

"To cut the *forfeit* from that bankrupt there."

XI.

IV., i., 76, 9—

"From such misery doth she cut me off."

This verse halts, and must be restored by reading—

"From such *a* misery doth she cut me off."

XII.

IV., i., 95, 7—

"Of one poor scruple; nay, if the scale *do* turn."

This lame verse can easily be cured by omitting the unnecessary auxiliary *do*. The termination of the verse is then, *if the scale turn*. This termination looks faulty at first sight, at least, if we apply the laws of classical versification. For there it is a fundamental principle that the last foot of every verse should represent the pure rhythm. The rhythm of the blank verse is iambic; the last foot, therefore, we might think, should not consist of two such words as *scale turn*, which can only be considered a spondee, and not an iambus. What makes this apparent neglect of the true iambic rhythm still worse, is the circumstance that in the preceding foot, *if the*, the rhythmical accent (the arsis) is on the short, insignificant article. I must confess this kind of verse is not pleasant to my ear. But they are so frequent in Shakspere, that we must look upon them as perfectly legitimate, and need not hesitate to introduce them in an emendation. In the "Merchant of Venice," alone, we have the following examples :—

II., i., 3—

"Pluck the young sucking cubs from the she-bear."

III., ii., 37—

"I have engaged myself to a dear friend."

IV., i., 91—

"I take this offer then: pay the bond thrice."

IV., i., 106—

"Therefore thou must be hang'd at the states' charge."

XIII.

IV., i., 133—

"And if your wife be not a mad woman."

The rhythm of this verse seems even more irregular than that of those we had just now under consideration. For here the last foot deviates more from the iambic rhythm than a spondee. It is a pure trochee, and, therefore, the verse reads precisely like a Greek skazon, *i.e.*, limping iambic verse, where the last foot is regularly and purposely a trochee, in order to produce a peculiar and almost ludicrous effect. But, upon closer examination, much of this oddity disappears. The expression, "mad woman," namely, is to be considered, not as two words, but as a compound substantive, the feminine of "madman." There is a difference in the accents on "mádman" and "mad mán"—the first is a trochee, the second an iambus. Just so, "mad wóman" differs from "mádwoman." The former has the accent on the penultimate, the latter on the antepenultimate. Now, by a fundamental law of the English language, in every word of three syllables, that syllable which immediately adjoins the accented syllable can, in poetry, be used as an unaccented (or short) syllable; and that syllable which immediately adjoins this short or unaccented syllable—and is, therefore, separated by it from the accented syllable—receives a secondary accent, and can, therefore, be used as long. Thus, in devoteé, disregárd, entertáin, the antepenul-

timate receives a secondary accent; in májesty, próvident, tówering, the ultimate does the same. Applying this rule to the word madwoman, we shall find that it can be scanned as amphimacer mádwomán, or in other words, that the second part of it, the word "woman" can change its original accent from that of a trochee to that of an iambus.

XIV.

V., i., 24—

> "*Jessica.* I am never *merry*, when I hear sweet music."

It is worth while to inquire what is the precise meaning of "merry." Surely, *Jessica* cannot mean to say that music makes her sad. She speaks in general of "sweet music," not of solemn adagios, only, that melt the heart, and produce that sweet, softening melancholy, so soothing and delightful. To get at the true meaning of "merry," we must widen the enquiry, and compare the opposite of "merry," viz., "sad." There is an obvious connection between "sadness" and "attention," "thoughtfulness" and "reflection;" and between "mirth," and "thoughtlessness," and "inattention." Thus, in "Midsummer Night's Dream," IV., i.—

> "Then, my queen, in silence *sad*,
> Trip we after the night's shade.

"Winter's Tale," IV.—

> "My father and the gentlemen are in *sad* talk."

Here, as Warburton observes, *sad* signifies only *grave, sober*. Blackstone quotes a statute—3 Henry VII., c. xiv., which directs certain offences, committed in the king's palace, to be tried by twelve *sad* men of the king's household. Here we have the *judex tristis* of Latin phraseology, who is not a sad melancholy judge, but one composed to serious attention and gravity, the very opposite quality of that which characterises the reveller and the merry-maker. This connection between

mirth and thoughtlessness is exemplified in Goldsmith's "Deserted Village," 122—

> "And the loud laugh that spoke the *vacant* mind,"

and 255—

> "Spontaneous joys, where nature has its play,
> Lightly they frolic o'er the *vacant* mind;"

and, on the other hand, how closely correlative are sadness and thought is shown in the same poem, v. 136—

> "The sad historian of the *pensive* plain"—

where "pensive" evidently means "mournful." *Jessica*, therefore, in saying she is not merry when she hears sweet music, means to imply that she cannot think of anything else —that she is riveted by music—that she must listen and attend to it; and this is precisely the sense in which Lorenzo takes it, and which he fully explains by saying—

> "The reason is, your spirits are attentive."

NINTH ORDINARY MEETING.

ROYAL INSTITUTION, 18th February, 1861.

The Rev. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

Dr. THOMSON having resigned his seat in the council, the Society was informed that Mr. MOORE, curator of the Free Public Museum, had been elected in his place.

Mr. MOORE exhibited a very fine specimen of a seal (*Callocephalus vitulina*), lately caught in the Canada Dock. The specimen has been well stuffed and mounted, and is about to be placed in the Museum, to which it was presented by Mr. Hulse, of Dale-street. Mr. Moore also exhibited a very

beautiful and interesting series of forty-four Canadian woods, lately presented to the Free Public Museum by Mr. Richard Reid Dobell.

Dr. Ihne having taken the chair, the President proceeded to read the paper of the evening,

ON "DARWIN'S THEORY OF THE ORIGIN OF SPECIES" (CONTINUED).

"SPECIES NOT TRANSMUTABLE." BY DR. BREE. (*Athenæum*, Nov. 3, 1860.)

After a short, but, on the whole favourable notice, of the above-named work, by Dr. Bree, the reviewer proceeds to give his own reflections, consequent upon a second perusal of Mr. Darwin's theory. These reflections seem to have been much influenced by the tone of Dr. Bree's work, from which the following is an extract:—"I cannot conclude without expressing my detestation of the theory, because of its unflinching materialism; because it has deserted the inductive track, the only track that leads to physical truth; because it utterly repudiates final causes, and thereby indicates a demoralized understanding on the part of its advocates." The question, can there be any just ground for such charges as these? if it be worth asking at all, seems necessarily to take precedence of every other inquiry on the subject. Are we then really, under the guise of philosophical inquiry, discussing whether or no there be a final cause? The theory, it is said, utterly repudiates final causes; then must its supporters be regarded as atheists. Details of natural history, however interesting, sink into insignificance if the controversy can reasonably be viewed under this aspect; for let it be remarked that the theory is accused of inconsistency, not with the Mosaic account of the creation, but with any belief in an Almighty Creator; and, in this respect, the accusation differs

entirely from that which was brought against what was, not very long since, the geological theory, but which is now geological science. It is well known how various have been the accommodations by which geologists have satisfied themselves of the consistency of the Mosaic account with their science; some have extended the six days into as many geological periods; one distinguished author considers the narrative of the creation to be an account of a vision seen by the sacred writer. In one way or in another, those who think it desirable to reconcile the letter of the Mosaic account with the "Testimony of the Rocks," succeed in doing so, at least to their own satisfaction.

But against the theory of the derivation of species, we have a charge which admits of no possible accommodation; which must be either false or fatal. Now, even if we are ready at once to pronounce it false, it is by no means uninteresting to inquire what is the gravamen in Mr. Darwin's theory on which is founded so solemn an indictment. It is to be hoped that the charge of repudiating a final cause is not brought against the theory because of its discrepancy with the Mosaic account of the creation. All real friends of the cause of revealed truth will deprecate its advocacy by any such means. We must, then, look to some more general view of creation, such as is supposed to be essential to the idea of a Creator, and examine if, with this, Mr. Darwin's theory can be shown to be incompatible. It seems, then, to be essential to any reasonable view of a Creator that the very existence of things should be regarded as having emanated simply from His will, without the employment of means of any kind, for such means would have to be created, and we are now speaking of the first origin of things. It seems also essential that the continuance of things should be regarded as the result of His approbation and constantly sustaining power. And as these seem to be essentials, so they seem to be the only essentials to the reasonable

acknowledgment of a Creator. I am not aware of anything in Mr. Darwin's theory opposing the reception of these propositions. But it has been very generally held that at whatever period of the history of the world any kind of living thing has first appeared, it has been the immediate result of a purely creative act, and we are now told that to question this is to question the existence of a final cause.

Now, if we turn from the organic to the inorganic world we shall there find no traces whatever of anything analogous to the successive acts of creation by which, as it is supposed, species were first produced. From the very beginning there has been one uniform course; not a trace can be found of any second touches. The laws of motion, of gravitation, of chemical affinity, of the distribution of light, heat, and electricity, have undergone no changes since the inconceivably remote ages of the Silurian formation. I see no reason for regarding this as inevitable. It is quite possible to conceive a course of things entirely different. The Will that at first worked without means could, at any subsequent time, have dispensed with them, and there might have been a world and an universe in which the phenomena of matter might have constantly presented the immediate results of supreme volition, just as species are supposed to have presented such results when first created. But who does not see that in such a world the position of man would be very different to that which he now occupies? Nature would wear an aspect wholly impenetrable. All material changes springing directly from the one great cause would, equally with that great cause, be inscrutable. Man's mind might be heaven-taught, but from earth he would learn nothing. From such a state of things the first exception, if it should please the supreme will to make one, and to employ a simple means to bring about a simple end, would be like the first beam of light; and just in proportion as these exceptions became more numerous, and the

all-prevailing will abstained from acting immediately, retiring further and further from material results, and employing principles and laws, which, after all, are only other names for means, just in such proportion would the phenomena of matter become charged with instruction, until, as it is now, the limit of their teachings would be found in the ability of man's intellect to receive them.

In the inorganic world of which we are speaking, elementary bodies hold a position somewhat analogous to that of species in the world of life; yet no one suspects any want of reverence towards a final cause in the suggestion that the truly elementary bodies may be much fewer than has been supposed. In the age when water was deemed to be an element, the question—How does water exist? would have been properly answered by a reference to the will of the Creator. We now know that water exists by the combination, under certain electrical conditions, of hydrogen and oxygen. Has our increased knowledge dishonoured the Creator? And if this is only one out of a thousand instances—if the dominion of law has no assignable limits—if the Creator has worked by means behind means indefinitely extended—why is it but that His operations might form a boundless field for man's investigation It is not contended that this or any other argument drawn from analogy in the inorganic world can prove the theory of Natural Selection; thus far, however, I think it is valid—it serves to show that the question of the origin of species may and must be open to fair investigation, without liability to the charge of impiety, on the ground of repudiating the existence of a first and final cause.

In the world of living creatures, we are far from regarding the life of any being as the immediate result of the Creator's will. A multitude of ascertained facts, relating to the sustenance and the reproduction of plants and animals, indicate the employment of means innumerable and profound. It may yet

happen that our knowledge may be still further extended, and that we may become acquainted with the laws which have governed the first introduction of species. If this should be the case, we may be quite sure the increased light will only reveal more of the benificient design with which the Creator has made provision for something of His own excellencies to be discernible in His works. It is, therefore, with regret that we read in a periodical professedly devoted to the cause of literature and science, remarks so little conducive to sound reasoning and truth as the following:—

"What does he really mean, for instance, by this Natural Selection, to which so much is attributed? If it operates as a presiding principle through innumerable ages—if it selects, assorts, distinguishes and preserves—if it gathers up manifold small increments, and rejects parts obsolete and unsuitable—if it aggrandizes small increments into great and long-enduring results—if it exercises a power that never fails, that is never hindered and never weakened—if it foresees its end through millions of years, and through all these years is ever controlling imperfection and contributing to perfection—and we think we find all these potencies variously, though vaguely, ascribed by Mr. Darwin to his supposed principle—if, we say, Natural Selection is and does all this—then it is either God, or it is a pestilent abstraction. If it be God, why not say so in the plain language of many men? If it be not God, what is it that you are attempting to set up upon altars where men usually worship Him? What is this wonderful power, to which you would give what most men regard as the inalienable prerogatives of Deity? Do not reply that, though it exists, we can know nothing of it—do not carry us back to Athens, where men ignorantly worshipped an unknown God. What is its significance? Is it human, or divine, or organic—a substance, an essence, or a shadow?"

Mutatis mutandis, all that is here said of Natural Selection,

unfairly and with exaggeration, might fairly be applied to gravitation in combination with the laws of motion. If it operates as a presiding principle through innumerable ages—if it prevails to the extent of the known universe—if it preserves order and has the power of eliminating elements of disorder—if it exercises a power that never fails, that is never weakened—if all things, the greatest as well as the most minute, are subject to it—if gravitation is, and does all this, which is truly the case, then, by the reviewer's argument, gravitation must either be God, or it is a pestilent abstraction.

Mr. Higgins proceeded to notice several other reviews, confessing his dissent from Mr. Darwin's theory, but regretting the manner in which it had been attacked.

TENTH ORDINARY MEETING.

Royal Institution, 4th March, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

The Rev. H. J. Hindley, M.A., and the Rev. C. D. Ginsburg, were elected members.

Mr. Moore exhibited a beautiful British fungus (*Peziza coccinea*), and some Myrabolans, covered with a Sphæria, probably of East Indian origin.

Mr. C. Spence remarked that he had never observed a similar growth upon the vast number of nuts that passed through his hands.

Mr. Duckworth exhibited a remarkably fine specimen of Apophyllite, a mineral allied to zeolite, from the Bore Ghât, between Bombay and Poonah.

Dr. Collingwood referred to the death of the old lion at the Regent's Park, which was found stretched one morning on the floor of its den. Messrs. F. Buckland and Quekett (of the Royal College of Surgeons), having examined it, came to the conclusion that it died of congestion of the lungs. A lion which lately died in Liverpool, Dr. Collingwood had the opportunity of examining. He found extensive pulmonary congestion, sufficient to cause death in this animal, which had been ailing for some weeks, having taken cold during its transit to this town in severe weather.

Dr. Collingwood also called attention to a paper, by Prof. Asa Gray, of Harvard University, reprinted from the *Atlantic Monthly Magazine*, entitled a "Free Examination of Darwin's Theory," and read from it some passages in which that eminent naturalist endeavoured to combine the two theories of *specific creation*, and *derivation of species* in a manner which would render the latter far less objectionable, particularly when it had to do with the introduction of the human race.

The following paper was then read :—

NOTES ON EARTH TEMPERATURES.

By DAVID WALKER, M.D., F.L.S., &c.

As the temperature of the earth performs a very important part in the promotion of vegetation, it has lately attracted the particular attention of meteorologists and naturalists, and I shall, in this paper, briefly touch upon the most important results deduced from comparisons of observations made in different parts of the world. In the consideration of the subject of terrestrial temperature, we must distinguish three different modes for the transmission of heat. The first with which we have to deal is, the varying amount of heat which penetrates from above downwards, or from below upwards, consequent on the different positions of the sun and the seasons of the year; this forms the most important source of heat, and is the principal agent in the maintenance of the different varieties of plants exhibited by the various zones of the earth that succeed each other, from the equator to the poles. The second mode of transmission, although present, is extremely slow, and has but little influence on the temperature of the earth near the surface—I refer to the heat which is propagated from the equatorial regions towards the poles, which heat being absorbed into the interior of the earth moves off laterally to those spots where the temperature is lower. The third mode, although the slowest of all, yet is ever acting, and has played a very important part in the former economy of our globe. During the solidification of the globe—which is commonly conjectured to have been gaseous and subsequently fluid, and to have been originally heated to a very high temperature—an enormous quantity of latent heat must have been liberated; this source of heat, existing in the centre of the earth, has been clearly

demonstrated by direct thermometrical observation in mines and artesian wells, and most unquestionably by the flow of molten masses from open fissures and volcanoes. The thinness of the crust of the earth in former epochs of its history, in the opinion of geologists, accounts for the presence of plants and animals in strata situated in latitudes too cold in our day to maintain such tropical productions. The rate of increase in the temperature of the earth, corresponding to the depth, has not been very accurately determined, as it partly depends upon the character of the strata through which the borings are made. The average increase of heat is 1° for every 56 feet; the artesian well at Grenelle, near Paris, shows an increase of 1° for every 59 feet. The temperature of the salt spring at Oeynhausen is 91°·04, an increase of 1° for every 54½ feet. I may here remark that the French philosopher Poisson denies that this increase of temperature is dependent upon the internal source of heat, and supposes that this warmth in the water of artesian wells is merely that which has penetrated into the earth from without, and the earth itself "might be regarded as in the same circumstance as a mass of rock conveyed from the equator to the poles in so short a time as not to have entirely cooled." It is a question often asked, whether the mean temperature of the surface of the earth has experienced any considerable change in the course of years? This is a question which has yet to be answered, as the comparatively recent general use of the thermometer causes a dearth in the means at our disposal for the investigation of this subject; we know, however, that the mean heat of the globe has not altered during the last 2,000 years, as the length of the day has not diminished by the hundredth part of a second, the length of a day being proportionate to the heat of the earth.

The periodic changes of temperature which have been occasioned on the earth's surface by the sun's position are

continued into its interior, although to a very inconsiderable depth; the slow conducting power of the ground diminishing this loss of heat in the winter is very favourable to deep-rooted trees. Points that lie at different depths in the same vertical line attain the maximum and minimum of the imparted temperature at very different periods of time; the further they are removed from the surface the smaller being the difference between the extremes. According to the accurate observations of Quetelet, *daily* variations of temperature are not perceptible at Brussels at the depth of $3\frac{4}{5}$ feet below the surface, and that at the same place, at 25 feet depth, the highest temperature was not indicated until Dec. 10th—the lowest was only observed on June 15th. Forbes, in his experiments on Calton Hill, found that at the depth of 24 feet in trap, the maximum temperature was not registered until January 8th. In Paris, Arago found that very small differences of temperature were perceptible 30 feet below the surface. The difference between the highest and lowest annual temperature diminishes in proportion to the depth, and, according to Fourrier, the difference diminishes in a geometrical proportion as the depth increases in an arithmetical ratio. We thus see that in every place there must be a certain depth at which the temperature will remain steady, and not fluctuate, according to the transmitted external heat—this is called the stratum of invariable temperature; and it depends not only upon the latitude of the place, and the conducting power of the strata, but also upon the amount of difference between the hottest and coldest seasons of the year. In our latitude the depth at which this stratum is found varies from 60 to 90 feet. At Paris, the temperature of the caves underneath the observatory is considered to be the temperature of the invariable stratum—this occurs at a depth of 86 feet, the temperature being 53°·30 F., the mean temperature of the air being 51°·48 F. At a depth of about 25 feet the influence of the seasons scarcely affects the oscillations

of the thermometer to the extent of half a degree. In tropical climates the invariable stratum is only some 10 to 14 inches below the surface. In the arctic regions, the depth of this stratum varies considerably. In the country of the Samoyedes in 67° N. latitude, ice was found at the depth of 5 feet in summer. In the Ural Mountains, 59° N. latitude, 5 feet was also the depth of the first-found ice. In Finmark, the temperature does not become so low as that of frozen soil. Franklin found, in August, that the ground was frozen at 16 inches' depth in the N.W. part of America. Richardson, upon the more eastern part of the coast in 71° N., found the depth, in July, to be 3 feet. The average of a number of observations which I made at Bellot Straits shews, in August, a depth of 14½ inches as the extent to which the summer thaw had penetrated; the depth varied from 12 to 17 inches, dependent upon the nature of the soil, being in some places clayey, in others mostly made up of shingle and mud. Seeman, the naturalist of the "Herald," in 1849, found that the depth of the summer thaw at Port Clarence, in Behring Straits, 66° N. latitude, extended from 2 feet in some places, to 4 or 5 feet in others, the latter occurring in sandy soil. On the northern coast line of America, Sir John Richardson found the depth of the thaw to extend only to 14 inches from the surface.

During the winter of 1858-9, I recorded the temperature of the soil at Port Kennedy, 72° N., 94° W., at two different depths. On the 14th September, I sunk a brass tube containing a delicate thermometer, vertically, 2 feet 2 inches in the soil. I found the ground frozen from 6 inches below the surface—the upper six inches was loose shingly soil, beneath it was a hard frozen yellowish mud—in sinking the tube more than one pickaxe was broken, so hard was the soil; the temperature of the ground was 31°·2. From the 4th October the surface of the ground over this thermometer became covered with snow, increasing in thickness till it was 84 inches deep;

the thermometer was registered every three or four days: it showed a pretty gradual decrease in the temperature until March 10th, when it was 0°·5. The mean temperature of the air during December being −32°·98; that of January, −33°·53; that of February, −36·06, *i.e.*, the mean winter temperature having been −34°·2. I may state that the mean annual temperature of this place was +2°·22; the mean summer temperature 37°·3. From the 10th March the temperature of the sunken thermometer gradually rose until July 11th, when it was at its highest, 31·8. The superincumbent snow at this time had all melted away, yet the three months' constant sunshine had not caused the ground at this depth to thaw; seeing that the mean summer temperature is only 37°·3, this may not be wondered at, but if we look at the direct amount of heat imparted to the ground from the sun's rays, it would be expected that the thaw would have penetrated more than 14½ inches. I have registered the black-bulb thermometer at 101°·5, the temperature in the shade being 49°·0; from the 28th April to the 28th July, the black-bulb thermometer never showed a temperature below 50°, with one exception, the temperature of the shade varying from +6 to +52°, thirty of those days the black-bulb being above 75°; yet the direct radiation of the sun during all spring and summer, until the declination has altered, is only employed in removing the covering of snow and ice which had accumulated during the winter, and producing a thaw to the extent of some 14 inches. On the 10th of March, a thermometer placed on the ground above where the 2 feet 2-inch thermometer was sunk, and covered by the superimposed snow, shewed its lowest temperature, namely, −3·8, indicating that at this time of the minimum temperature in both thermometers, the covering of snow created a difference of temperature of 4·3° between the deep ground and surface thermometers. On the 26th of February, another thermometer sunk 1 foot 1 inch through

shingly soil, uncovered by snow, shewed its minimum −25·7, the temperature of air at the time being −38·2, the mean temperature for 9 preceding days having been −37°·4. The temperature registered by this thermometer gradually rose from the 26th February to the 28th July, when it shewed its maximum 44°·8, the temperature of air being 42·9, and the mean air temperature for previous 9 days being 42°·6.

From this series of experiments, the difference between the loose shingly soil and the close mud, as to their heat-transmitting power, will be evident; also the effect of a covering of snow in preventing nocturnal radiation; and also in moderating the direct influence of the sun's rays.

It will be evident from these, and also from similar experiments made in other parts of the world, that the mean temperature of the soil at certain fixed points from the surface is, to a great degree, the cause of the climatic and agricultural differences of any district, such temperatures being dependent upon the temperature of the air, and the nature of the surface covering of the ground at those places. This leads me to the consideration of the temperature of the earth as to its hypsometrical relation, or as it regards its altitudinal range. As the temperature of the air decreases about 1° for every 350 feet in height, it follows that the relative temperature of the earth will also decrease; we thus ultimately reach the line of perpetual congelation, or the snow line; its limit does not exactly correspond with the height at which the temperature is equal to 32° F. In the tropics, the height of the snow line is some 15,000 feet, whilst at 70° N. it comes down to 1,700 feet; and at the poles it will be at a minimum height, 0. The same changes which take place from the equator to the poles, on the level surface ground, will also occur on lofty mountains, such heights regulating, in a great measure, the vegetation, so that we may have an arctic flora in the tropics. Although the mean annual temperature of many places

in lat. 75° N., be as low as zero, yet the snow line is not so low as one would imagine. Near the poles, the direct rays of the sun are aided by the radiation and reflection of its rays from large tracts of land, compensating in a great degree, the obliquity of the sun's rays during the evening and night; the heat is also increased by the presence of currents of warm water moderating the cold winds. In ascending a mountain at Disco Island, about 70° N., I found plants of Saxifraga, Cerastium, Salix, and Draba up to 2,500 feet, and the first two up to 3,000 feet; at 3,350 feet, I found the Cerastium alpinum, also lichens adhering to the rocks where they had been denuded of snow by the direct rays of the sun. I found six species of Saxifraga, with many other phanerogamic plants, and lichens, at 1300 feet high, on a mountain at the head of Port Kennedy, 72° N., 94° W.

A few words, in conclusion, as to the mode of taking earth temperatures. Meteorologists generally, now, confine their observations to a very moderate depth in this climate. Of course, in foreign lands where new observations would be of great value, such statement does not hold true. Ranges from the surface of the ground to depths of 3 feet are those most generally used. One set of experiments is of considerable value, namely, the register of a thermometer whose bulb is just covered with a thin sprinkling of earth, exposed to the rays of the sun. At 6, 13, 19½, 26, and 39 inches, the temperature is now pretty widely recorded. The usual mode of registering is, to sink a brass tube, closed at the one end, vertically through the soil to the required depth, and to place in it a delicate thermometer, with a long stem, having its bulb well padded, so that the temporary exposure of the thermometer to the air, whilst it is being read off, may not affect its indication; the upper end of the tube may be protected by a sod of earth laid on it. Another method is to place in the ground a thermometer having its stem enclosed in wood up to the

surface of the earth, the stem continuing upwards above the surface, having a metal scale with the degrees marked upon it. I think both these means of registering defective, and have used for some months past a different mode. I had a tube of wood made 9½ inches long, and at its lower extremity I attached a brass tube of 3½ inches, this was sunk in the ground; instead of having a long thermometer in this tube, I obtained a small one 3½ inches long finely graduated to read easily to one-tenth of a degree. I find that this instrument answers admirably, giving more correct readings than either of the other two. For three months, I have compared the results shown by all three instruments. I find that the metal of the brass tube conducts not only the temperature of the air, but also the temperature of the upper part of the soil, so that the thermometer registers the temperature not at 13 inches depth, but of the whole 13 inches of soil through which the tube passes. The wooden instrument, also, is open to objection, as not only the wood, but also the long glass and contained mercurial stem, are influenced by the temperature of the air, &c. The object of the wood in the upper portion of my instrument is to reduce the conduction from the air to a minimum; whilst the 3½ inches of metal gives the temperature of the soil at that depth to the thermometer, which is only the same size.

I do not wish to enter into the question of isothermal, isotheral, or isocheimonal lines—it would enlarge this paper beyond my wishes. I may conclude by stating that the comparison of temperatures of the earth or soil at moderate depths, and the deductions to be drawn from them, are of great importance not only to the physiological, but also to the practical, botanist.

The following paper was also read—

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A few words, in conclusion, as to the mode of taking earth temperatures. Meteorologists generally, now, confine their observations to a very moderate depth in this climate. Of course, in foreign lands where new observations would be of great value, such statement does not hold true. Ranges from the surface of the ground to depths of 3 feet are those most generally used. One set of experiments is of considerable value, namely, the register of a thermometer whose bulb is just covered with a thin sprinkling of earth, exposed to the rays of the sun. At 6, 13, 19½, 26, and 39 inches, the temperature is now pretty widely recorded. The usual mode of registering is, to sink a brass tube, closed at the one end, vertically through the soil to the required depth, and to place in it a delicate thermometer, with a long stem, having its bulb well padded, so that the temporary exposure of the thermometer to the air, whilst it is being read off, may not affect its indication; the upper end of the tube may be protected by a sod of earth laid on it. Another method is to place in the ground a thermometer having its stem enclosed in wood up to the

surface of the earth, the stem continuing upwards above the surface, having a metal scale with the degrees marked upon it. I think both these means of registering defective, and have used for some months past a different mode. I had a tube of wood made 9½ inches long, and at its lower extremity I attached a brass tube of 3½ inches, this was sunk in the ground; instead of having a long thermometer in this tube, I obtained a small one 3½ inches long finely graduated to read easily to one-tenth of a degree. I find that this instrument answers admirably, giving more correct readings than either of the other two. For three months, I have compared the results shown by all three instruments. I find that the metal of the brass tube conducts not only the temperature of the air, but also the temperature of the upper part of the soil, so that the thermometer registers the temperature not at 13 inches depth, but of the whole 13 inches of soil through which the tube passes. The wooden instrument, also, is open to objection, as not only the wood, but also the long glass and contained mercurial stem, are influenced by the temperature of the air, &c. The object of the wood in the upper portion of my instrument is to reduce the conduction from the air to a minimum; whilst the 3½ inches of metal gives the temperature of the soil at that depth to the thermometer, which is only the same size.

I do not wish to enter into the question of isothermal, isotheral, or isocheimonal lines—it would enlarge this paper beyond my wishes. I may conclude by stating that the comparison of temperatures of the earth or soil at moderate depths, and the deductions to be drawn from them, are of great importance not only to the physiological, but also to the practical, botanist.

The following paper was also read—

ON MR. C. W. WILLIAMS' THEORY OF "HEAT, IN ITS RELATION TO WATER AND STEAM."

By the Rev. W. BANISTER, B.A.

After a short preliminary introduction, the Rev. W. Banister said—I shall endeavour, this evening, to lay before you, briefly and popularly, some of the salient points in Mr. C. Wye Williams' lately published work on "Heat, in its relation to Water and Steam."

Mr. Williams makes, what will seem to most people, the startling assertion, that water cannot be *heated*, and still retain its liquid form and character—that there is no such thing as hot water—that the liquid which we use in shaving, in which we infuse our tea or coffee, with which we mix our grog, or in which we plunge our feet when we have a cold in the head, is not, correctly speaking, hot at all; the *liquid* in the tea-kettle, in the fiercest state of ebullition, is no hotter than when it came out of the pump; it is cold water and hot steam mixed.

The foundation, then, of his theory is, that—beyond that temperature at which water must be under a given pressure to be fluid, and not ice—it is impossible to add heat without turning a given portion of the water into vapour or steam, which are convertible terms, the force of the latter being due, not to any difference in its nature, but in quantity—vapour is steam, and *vice versà*.

Mr. Williams extends the operation of Dalton's celebrated law of the diffusion of gases so as to include the vapour of water.

According to that law, the tendency of the ultimate atoms

of which *liquids* are composed, and of those of which *gases* are composed, is directly contrary; the ultimate atoms of a *liquid* tend to run together, to unite—those of a *gas*, to fly off and separate; the one kind are mutually attractive—the other mutually repellent—their natures are utterly diverse. A drop of water will form a bead at the bottom of a tumbler—the same bulk of gas or vapour will expand and fill the whole of the vessel.

Hitherto, it has been denied that vapour of water obeys this law; Dalton made no reference to it, Mr. Williams thinks, out of deference to the great genius of Watt, but that both would now readily include it; for Watt conceived that steam could not come into contact with water without being condensed; but Mr. Williams has carried steam generated in one vessel through a succession of four or five more without condensation. Heat is applied to the first, and steam is generated to the point of saturation—it then flows through a pipe from the top into the second vessel of cold water, gradually saturates this with vapour, and so on; it might be carried through an unlimited series if the first vessel were supplied with water. Indeed, Dalton said—"Vapour cannot, on any scientific principle, be classed in a distinct category from elastic fluids, retaining its elasticity and repulsive power among its own particles."

Mr. Williams, therefore, assumes as proved that the vapour of water behaves as all other elastic fluids do. *In whatever medium they are, dense or rare, water or air, they arrange themselves so as to pervade the whole of it*—equally—as if they were in a vacuum; and to diffuse themselves downwards as well as upwards, though the latter more quickly.

If you apply heat beneath and against the whole of the bottom of a vessel of water, the temperature in the *mass* is increased with remarkable uniformity. [This was here illustrated by experiments.] This cannot be due to the

conduction of heat by the water, for water is considered as a non-conductor; nor to the water revolving, and having all its particles heated in succession, for the *temperature becomes homogeneous instantly on the heat being applied, and long before there is time for this to take place.* Again, the heat of the steam in the space above the water-line is the same as that shewn in the water; so that unless steam and water can be of the same temperature—which he thinks impossible—the identity of temperature must be due in both cases, *i.e.*, in and out of the water, to the same cause, steam, pervading water and air alike; and, moreover, on the escape of steam, the temperature is suddenly reduced.

Before bringing before you some of the experiments which confirm Mr. Williams' views, it may be well to quote the opinions of writers of scientific eminence, who give different explanations of the phenomena in question. Vid. p. 31, 33, et seq., in Mr. Williams' book on "Heat, in its relation to Water and Steam:"

On the application of heat to the bottom of a vessel containing water, the lowest stratum of liquid particles in contact with the bottom will be instantaneously converted into vapour—from being attractive they will become mutually repellent—they will become specifically lighter, and have a tendency to rise, and their volume will increase as they ascend in consequence of the diminution in pressure. They will not ascend with strict regularity, but, owing to the descent of heavier particles of water meeting them, will adopt a sinuous and wavy direction. The layer of liquid which succeeds them is treated in the same way, and sent up after the first; if the process be continued, all will be turned into steam. If, when the water is charged with a considerable quantity of these vapour atoms, or particles, you look through it by the light of a lamp placed on the farther side, you will *see* the steam ascending, like spirit in water, distinctly. If the heat be continued, the whole

of the water will be saturated with vapour, and the thermometer will indicate 212°, or boiling point; but there need be no ebullition—if the water be perfectly pure there will be none. (Experiment.) But that the steam *is* in the innocent-looking liquid will be plain if you introduce a wooden stick or rod. Wherever you place the point, steam collects—where does it come from, if not in the water? the cool rod cannot generate it. To make this more clear, let us take a vessel in which a permanent source of attraction is set up in the form of a cross made of pounded brick, stuck on by paint. It is thus shewn, says Mr. Williams, "that the ebullition is purely accidental, and has no reference to the *generation* of vapour, and that it is solely the result of the aggregation of myriads of atoms *previously* formed, and irrespective of the heat transmitted and absorbed in any particular locality."

To shew the force of the ascensional power of steam atoms, Mr. Williams puts a quantity of pounded coal into a vessel of water, through which the steam forces its way—forcing the particles upwards like so many explosions.

Mr. Williams denies that water is expansible, as it is acknowledged to be nearly incompressible. He requires the application to liquids of the admitted law as regards solids—"that dilatation and compression are correlative terms."

"If," he says, "dilatation and compression are treated as being reciprocal and proportionate when spoken of in relation to solids, why draw a contrary inference in relation to liquids? If iron *contracts considerably under cold, and expands considerably in same proportion under heat*, why not say that, as liquids are nearly incompressible, they must be nearly inexpansible?"

Again, water wanting the power of readily conducting heat from one particle to another, cannot communicate a sufficient amount of heat to make the *mass* expand, as would be the case in a solid; for, if one particle cannot *give*, its neighbour

cannot *receive* heat from it. If you insert a long tube in a flask of water, so that the water shall rise a certain height in the tube, and apply heat to the bottom of the flask, the column of water in the tube will at first *fall*, because the glass, though solid, expands more quickly than the water, so allowing the latter more room; it will soon rise, however, but the expansion is due to the larger bulk of the particles of steam generated, and not to the expanded water.

With regard to condensation, Mr. Williams contends that steam is not condensed by cold water, for several reasons:—

1st. If steam were condensed by contact with cold water, the *first steam generated* must be *immediately* condensed by the cold water with which it would be at first in contact; you never could get beyond a succession of vaporisations and condensations—no *body* of vapour could be formed.

2nd. A small jet of steam discharged into a large body of water is capable of almost instantly raising the whole to 212°.

3rd. Steam, as we have seen previously, may be carried through a series of vessels containing cold water.

I shall only add a short notice of his theory regarding the interesting subject, both to cooks and captains, of Boiler Explosions.

If I rightly understand him it is, that explosions rarely occur from deficiency of water, any further than that such deficiency may cause injury to the boiler plates from over-heating; but they arise from the sudden escape of the steam contained *in* the water. (Of course, on his principle, the more water the more steam.) If, then, the engine has been at rest for some time, but heat continuously supplied to the bolier, both the water in the boiler and the space above it will be *heavily charged* with steam; *so long as the equilibrium is maintained all will be well;* but if, from any cause—such as the injection of water from the feed pipe, producing a tumultuous aggregation of steam atoms, or by opening the valves and starting

the engine—a quantity of steam be suddenly liberated, a tremendous rush of steam, both from the chamber above, and from the body of water, carrying a quantity of the latter with it, and gaining increased momentum on escaping from the denser medium, hurls itself with such precipitation at the valve (like a mob to the door where a theatre is on fire), that it misses its object, and is thrown violently against the crown of the boiler; and should any part of this be previously at its maximum strain, the impetus is irresistible.

The paper was illustrated by experiments in proof of Mr. Williams' views, under the charge of Dr. Edwards.

ELEVENTH ORDINARY MEETING.

Royal Institution, 18th March, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. T. S. Walker, M.R.C.S., and Mr. G. Searle Wood, were elected members.

The names of numerous visitors were announced.

Mr. J. O. Fabert exhibited several beautiful specimens of Gorgonia, &c., from the West Indies, and some remarks were made by the Chairman upon their peculiar mode of growth.

Mr. Moore exhibited a large collection of furniture and ornamental woods, the produce of the Canadian forests. They consisted of forty-five specimens, comprising ash, birch, cedar, elm, maple, chestnut, walnut, oak, &c., and were collected by Mr. William Quinn, supervisor of Cullers, Quebec, who was present, and made some remarks concerning them.

Dr. COLLINGWOOD read an extract from a private letter which he had received from Professor Agassiz, of Cambridge, U.S., in which that gentleman proposed to enter into a correspondence with the society for exchange of specimens between the museums. He had referred the subject to Mr. Moore, of the Derby Museum, by whom it had been warmly taken up, and who had taken advantage of the return of the steamship "Canada" to send the professor a small packet as an earnest of future correspondence. The letter of Mr. Agassiz had been kindly brought him by Captain Anderson, of the Cunard steamship "Canada," a gentleman who took a great interest in thesubject of Natural History, and who was willing to be the medium of communication with Prof. Agassiz.

Dr. COLLINGWOOD also referred to a memorial to the Committee of the Mercantile Marine Association, extracts from which be read to the meeting, in which was proposed a scheme for the encouragement of studies among the captains and sailors of the Mercantile Marine, which might be expected to improve their own morals and benefit science. It further insisted upon the value which would accrue from the more general collection by such men of natural objects from all parts of the world for the enrichment of our museum, and recommended them to avail themselves of the opportunities which would be offered by the proposed School of Science. Dr. Collingwood announced that this memorial had been that day laid before the committee of the Mercantile Marine Association, by whom it was favourably received, and ordered to be printed; and would, moreover, appear in *The Albion*, of the following Monday (March 25), an announcement which caused general satisfaction to the meeting.

Mr. HENRY DUCKWORTH explained briefly, with the aid of a chart, the leading points in Mr. Consul Petherick's expedition to the sources of the Nile, which is intended as an auxiliary to the prime expedition already dispatched to the

same goal by way of Zanzibar, under the conduct of Captains Speke and Grant. Supported by an escort furnished him by the amiable Prince of Zanzibar, Captain Speke will retrace his steps to the point of his last important discovery, the Lake Victoria, Nyanza. The intervening country being peopled by comparatively friendly tribes, the travellers will experience only the ordinary difficulties of transport during their passage through it. It is in their progress northward to Gondokoro from Lake Nyanza, which will be thoroughly explored with a view to determining whether or not it is the mother of the Nile, that the party will encounter the greatest difficulties, for not only, according to Mr. Petherick, are the languages of the aborigines different from those known south of the equator, but, unaccustomed to strangers, their hostility towards them, and to neighbouring tribes is very great. Again, unless the expedition reaches Gondokoro in December or January, when Khartoum traders visit the place for the purpose of barter, it will be unable to proceed down the Nile, and, after a drain upon its resources of from twelve to fifteen months (the time which Captain Speke calculated it will take to reach Gondokoro from Zanzibar), its position will be not a little critical. It is at this point that Mr. Petherick proposes to step in. Setting out from Khartoum, his first object will be to form a sufficient depôt of grain at Gondokoro, under the charge of his own men, to ensure to Captain Speke means of subsistence and security from violence whenever he should reach that place. 2ndly. To explore the country between Galuffi and Lake Nyanza; and, 3rdly. To effect a meeting with Captain Speke, and assist him through the hostile tribes between the Lake and the Nile. Mr. Petherick estimates that the cost of this additional expedition will be only £2,000. "Spes sit mihi certa videndi Niliacos fontes, bellum civile relinquam," are words which Lucan has put into the mouth of Julius Cæsar; but, judging from the manner in which the people of

Britain have responded to the appeal of the Royal Geographical Society, they are far from being actuated by the same spirit. Little more than half the necessary amount has as yet been subscribed. Nevertheless, Mr. Petherick has nobly determined to adhere to his original plan, and endeavour to reach Gondokoro next November. He will then explore until March, 1862, when the setting in of the rainy season prevents further movements. Starting afresh in August, 1862, he proposes to continue his travels till February, 1863, and after that to return to Gondokoro, reaching his depôt at the end of 1863, or early in 1864. By last accounts, dated 15th October, Captain Speke was at Kidunda, in lat. 7° 20' S., and lon. 38° 8' E.

The following paper was then read :—

THE PARSEE RELIGION.

By DADABHAI NAOROJI, Esq.

(Professor of Gujarati in the University of London.)

Like a soldier suddenly called to perform his movements before a body of veteran officers, after having given up his military habits for several years, I feel embarrassed and awkward on being required to read a paper before a learned society such as this, after having been, for the past six years, unused to the habits of thought, reading, and composition, necessary for such a task. I have endeavoured, however, to do what I could, under the circumstances, and as far as my limited leisure permitted.

I will first give some account of the present state of the knowledge of the Parsees about their religion. The priests are a separate caste, and the priesthood is thus hereditary. As a body, the priests are not only ignorant of the duties and objects of their own profession, but are entirely uneducated except that they are able to read and write, and that, also, often very imperfectly. To read and write they must learn, as they have to prepare by rote a large number of prayers and recitations, which, in the performance of their usual avocations, they are required to recite. Their work chiefly consists of reciting certain prescribed prayers on various religious occasions; to go to the fire-temple or sea-shore, and say a prayer for anybody that chooses to give a halfpenny; and to depend upon charities distributed on various joyous or mournful occasions. They do not understand a single word of these prayers or recitations, which are all in the old Zend language.

From the state of their education and knowledge, they are

quite unfit for the pulpit; nor do they aspire to it, or seem to have any notion of the necessity of such teaching. The Parsees have, therefore, no pulpit at present. Far from being the teachers of the true doctrines and duties of their religion, the priests are generally the most bigoted and superstitious, and exercise much injurious influence over the women, especially, who, until lately, received no education at all.

The priests have, however, now begun to feel their degraded position. Many of them, if they can do so, bring up their sons in any other profession but their own. There are, perhaps, a dozen, among the whole body of professional priests, who lay claim to a knowledge of the Zend Avestá, the religious books of the Parsees; but the only respect in which they are superior to their brethren is, that they have learnt the meanings of words of the books as they are taught, without knowing the language, either philologically or grammatically. They have been taught certain meanings for certain words, and they stick to them as a matter of course. I doubt much whether any one of them has a clear notion of what grammar is, and as to a liberal education, they never had it, and do not, in consequence, understand the necessity of it.

Such being the state of knowledge of the religious guides and teachers among the Parsees, it may be easily conceived what could be expected from a layman. The whole religious education of a Parsee's child consists in preparing by rote a certain number of prayers in Zend, without understanding a word of them; the knowledge of the doctrines of their religion being left to be picked up from casual conversation. Under these circumstances, a Parsee has not much opportunity of knowing what his creed really is; the translation, besides, of the Zend books, in the present vernacular of the Parsees, being of very recent date. But, unfortunately, this translation is a constant subject of dispute among the dozen would-be learned priests alluded to before. This shameful want of the

means of religious education, and its slight extent among the Parsee children, have of late attracted the attention of the community, and efforts are being made to supply the deficiency.

In my ignorance of the Zend language, I cannot do more than depend upon this translation, though considered to be somewhat imperfect. But, for the purposes of a paper like this, the object of which is to give a general outline of the doctrines of the Parsee religion, I think these materials will suffice.

The traditional number of the books of the Zend Avestá is twenty-one, of which there are only three extant, and parts of two more, viz., the Yazashné, the Vandidád, and the Khordeh Avestá, and a part of the Visparad, and Vistásp Nusk.

There is a dialogue, in the vernacular, appended to the Khordeh Avestá (small Avestá), which, I think, gives a sufficiently accurate outline of the present belief of nearly the whole of the orthodox body. I do not know of a certainty who its author is. It has been composed more than a quarter of a century ago, when English ideas and education had not made much progress; and is, therefore, I think, the more valuable, as a faithful representation of the belief of the general mass.

The Khordeh Avestà is a collection of prayers addressed to God and several angels, and it is some of these prayers, the preparation of which by rote, forms the staple of the religious education of the Parsee child. At the end of this book is appended the dialogue, in the vernacular; and intelligent priests, masters, and parents, that could read, welcomed this aid, imperfect though it is, and a little irrelevant.

The subject of the dialogue is thus described:—

"A few questions and answers to acquaint the children of the holy Zarthosti community with the subject of the Mazdiashná religion (*i.e.*, of the worship of God). Dialogue between a Zarthosti master and pupil:—

Ques. Whom do we, of the Zarthosti community, believe in?

Ans. We believe in only one God, and do not believe in any besides Him.

Ques. Who is that one God?

Ans. The God who created the heavens, the earth, the angels, the stars, the sun, the moon, the fire, the water, or all the four elements, and all things of the two worlds; that God we believe in—Him we worship, Him we invoke, and Him we adore.

Ques. Do we not believe in any other God?

Ans. Whoever believes in any other God but this is an infidel, and shall suffer the punishment of hell.

Ques. What is the form of our God?

Ans. Our God has neither face nor form, colour nor shape, nor fixed place. There is no other like Him; he is Himself singly such a glory that we cannot praise or describe Him; nor our mind comprehend Him.

Ques. Is there any such thing that God even cannot create?

Ans. Yes; there is one thing which God himself even cannot create.

Ques. What that thing is, must be explained to me.

Ans. God is the creator of all things, but if he wish to create another like Himself, he cannot do it. God cannot create another like Himself.

Ques. How many names are there for God?

Ans. It is said there are one thousand and one names; but of these one hundred and one are extant.

Ques. Why are there so many names of God?

Ans. God's names, expressive of his nature, are two, "Yazdan" (omnipotence), and "Páuk" (holy). He is also named "Hormuzd" (the highest of spirits), "Dádár" (the distributor of justice), "Purvurdegár" (provider), "Purvurtar" (protector), by which names we praise him. There are many other names, also, descriptive of his good doings.

Ques. What is our religion?

Ans. Our religion is, "Worship of God."

Ques. Whence did we receive our religion?

Ans. God's true prophet—the true Zurthost [Zoroaster] Asphantamán Anoshirwán—brought the religion for us from God.

Ques. Where should I turn my face when worshipping the holy Hormuzd?

Ans. We should worship the holy, just Hormuzd with our face towards some of his creations of light, and glory, and brightness.

Ques. Which are those things?

Ans. Such as the sun, the moon, the stars, the fire, water, and other such things of glory. To such things we turn our face, and consider them our "kibleh" (literally, the thing opposite), because God has bestowed upon them a small spark of his pure glory, and they are, therefore, more exalted in the creation, and fit to be our "kibleh" (representing this power and glory).

Ques. Who was this true prophet, the true Zurthost?

Ans. The son of Porosaspé, who was the son of Pétéraspé, was the excellent Zurthost Ashphantamán Anoshirwane—chief of the wise, and the king of the learned—the worshipper of God. Him did God exalt over all mankind, admitted to his own presence; and by him did God send us his good Mazdiashná religion. *He* has been our prophet.

Ques. Have we had any other prophet after Zurthost?

Ans. No; we should remain attached with sincere faith to the religion brought by him.

Ques. Among the creation of Hormuzd in this world, which is the most exalted, and which the lowest?

Ans. The great prophet is the most exalted, and that prophet is the excellent Zurthost—none is higher than he; the height of dignity culminates in him, because he is the most beloved and honoured of God. The servant of all is iron.

Ques. What religion has our prophet brought us from God?

Ans. The disciples of our prophet have recorded in several books that religion Many of these books were destroyed during the Alexandrian conquest, the remainder of the books were preserved with great care and respect by the Sassanian Kings. Of these again the greater portion were destroyed at the Mahommedan conquest by Khalif Omar, so that we have now very few books remaining, viz., the Vandidad, the Yazashné, the Visparad, the Khordeh Avesta, the Vistasp Nusk, and a few Pehlvi books. Resting our faith upon these few books, we now remain devoted to our good Mazdiashna religion. We consider these books as heavenly books, because God sent the tidings of these books to us through the holy Zurthost.

Ques. What other books had we during the times of our kings ?

Ans. Innumerable on all subjects of learning, but the enemies of our religion and sovereignty translated them in their own languages, and thus, after usurping our wisdom, destroyed our ancient Persian and Pehlvi works.

Ques. In what king's time did our prophet live ?

Ans. When a just and God-worshipping king, by name Gushtàshp [Hystaspes] the son of Lohorósp reigned. When Jámásp was the sage, and Rustam the great warrior, did our prophet bring the Mazdiashna religion from God. He performed many miracles and refuted the sages of Greece and India by such miracles; then the King Gushtáshp, the sage Jámásp, and the sages of Greece and India, believed in the religion brought by Zurthost and accepted it.

Ques. Are our prophet's miracles recorded any where ?

Ans. Long accounts were recorded in our ancient books, of which we have some portions extant. The wise and learned Greeks of the time had also recorded the miracles and wisdom and truth of our prophet, but their ignorant successors have, from envy, altered and misrepresented those records. Notwithstanding this, there are still some evidences in the old Greek books.

Ques. What religion prevailed in Persia before the time of Zurthost?

Ans. The kings and the people were worshippers of God, but they had, like the Hindoos, images of the planets and idols in their temples. This religion is now designated the Poriódakesi, which appears to be a mistake, for it seems the religion of the Persians before Zurthost, was called Farsandaji Kós, and its followers Farsandaji Kisán, while it is those that adopted Zurthost's religion, were called the Poriodekesians.

Ques. Whose descendants are we?

Ans. Of Gayomars. By his progeny was Persia populated.

Ques. Was Gayomars the first man?

Ans. According to our religion he was so, but the wise men of our community, of the Chinese, the Hindoos, and several other nations, dispute the assertion, and say that there was human population on the earth before Gayomars.

Ques. What commands has God sent us through his prophet, the exalted Zurthost?

Ans. Many are those commands, but I give you the principal, which must always be remembered and by which we must guide ourselves:—

To know God as one; to know the prophet, the exalted Zurthost, as his true prophet; to believe the religion and the Avestá brought by him, as true beyond all manner of doubt; to believe in the goodness of God; not to disobey any of the commands of the Mazdiashná religion; to avoid evil deeds; to exert for good deeds; to pray five times in the day; to believe in the reckoning and justice on the fourth morning after death; to hope for heaven and to fear hell; to consider doubtless the day of general destruction and resurrection; to remember always that God has done what he willed, and shall do what he wills; to face some luminous object while worshiping God.

Ques. If we commit any sin, will our prophet save us?

Ans. Never commit any sin under that faith, because our prophet, our guide to the right path, has distinctly commanded "you shall receive according to what you do." Your deeds will determine your return in the other world. If you do virtuous and pious actions, your reward shall be heaven. If you sin and do wicked things, you shall be punished in hell. There is none save God that could save you from the consequences of your sins. If any one commit a sin under the belief that he shall be saved by somebody, both the deceiver as well as the deceived shall be damned to the day of "Rastá Khez," (the day of the end of this world). * * *

Ques. Have any persons endeavoured to deceive the people by offering to intercede for them and to save them?

Ans. Some deceivers, with the view of acquiring exaltation in this world, have set themselves up as prophets, and going among the labouring and ignorant people, have persuaded them that, "if you commit sin, I shall intercede for you, I shall plead for you, I shall save you;" and thus deceive them, but the wise among those people know the deceit. They do not, however, dare to speak their mind for fear of the deluded multitude. Our prophet needed no exaltation here, he was exalted before God, and he told us the true command, "you shall receive according to your deeds." There is no saviour. In the other world you shall receive the return according to your actions. * * * Your saviour is your deeds, and God himself. He is "Bakhsháyandé," (the pardoner), and "Bakhsháyazgar," (the giver). If you repent your sins and reform, and if the great judge consider you worthy of pardon, or would be merciful to you, he alone can and will save you.

Ques. Why are God and his prophet addressed in the rude singular "thou," instead of the polite plural "you?"

Ans. Because God is only *one*, and there is none like him, and there is only *one* prophet.

Ques. What are those things by which man is blessed and benefitted ?

Ans. To do virtuous deeds, to give in charity, to be kind, to be humble, to speak sweet words, to wish good to others, to have a clear heart, to acquire learning, to speak the truth, to suppress anger, to be patient and contented, to be friendly, to feel shame, to pay due respect to the old and young, to be pious, to respect our parents and teachers. All these are the friends of the good men and enemies of the bad men.

Ques. What are those things by which man is lost and degraded ?

Ans. To tell untruths, to steal, to gamble, to look with wicked eye upon a woman, to commit treachery, to abuse, to be angry, to wish ill to another, to be proud, to mock, to be idle, to slander, to be avaricious, to be disrespectful, to be shameless, to be hot-tempered, to take what is another's property, to be revengeful, unclean, obstinate, envious, to do harm to any man, to be superstitious, and do any other wicked and iniquitous action. These are all the friends of the wicked, and the enemies of the virtuous.

Such is the religious knowledge which the Parsees of more than a quarter of a century ago endeavoured to communicate to their children, or at least wished them to be taught, but I do not think that even this dialogue had been, till very lately, made a necessary part of the child's religious education. From one question quoted, not quite bearing upon the Parsee religion, but evidently meant for a reason against Christianity, it may have struck the reader that this dialogue was perhaps written under the pressure of the efforts of Christian missionaries to convert Parsee youths.

It remains, however, to be seen how far the doctrines and injunctions taught in this dialogue are authorised by the Zend Avestá, and what other doctrines are taught in them. The best thing I can do, I think, is to give here a series of

extracts from the translation of one of these Zend books, sufficient to give a faithful general notion of the doctrines and morality of the Zoroastrian religion.

I have given extracts from only one of the books, as I have not had time enough at my disposal to study and extract from the others. This book, the Yazashné, is divided into seventy-two chapters called "Há." Of the first "Há," I give an abstract of almost the whole, as from it will be at once obtained some idea of the peculiarities of this religion:—

"The great judge, Hormuzd, full of glory and brightness, I invoke. The highest, the all-virtuous, the greatest, the strictest, the all-wise, of the purest nature, the holiest, lover of gladness, the invisible among the invisible, the increaser. He created our soul—He moulded our body—He gave us existence. Him I invoke, and complete this Yazashné. Good conscience, high piety, love of excellence, high and perfect thought, Khordad and Amardad, the sheep and their souls, the fire of God, all other angels that reach us, the time of day which is exalted by holiness, the early dawn—all these I remember or invoke in this Yazashné. The morning angels "Sawang" and "Vis" that are exalted by holiness, the angel "Meher," the lord and guardian of the forest of thousand ears and ten thousand eyes, gladness and comfort, the noon time of day and its angels, "Furádádáre" (Fasé) and "Jand." The afternoon time of day and its angels, "Furádádare Vir," and "Deh," exalted by holiness. The angel "Burzo," of the source of water, and the waters created by God. The night time of day and its angels, "Furádádáre Visp," "Hujivas," and "Zurthosturotum," the holy souls of men and women, the year that is spent in virtue and excellence, and the great and brave, created by God, beautiful and victorious. [I know not who is meant here—the translator puts in the angel "Behram."] The time after midnight and its angels, "Berej," and "Numan," exalted by holiness, the

angel "Surosh," the prayerful and victorious, and the promoter of things in the world, the just "Rashné," and "Astad" the bestower of freshness to creation—all these I invoke or remember, and complete this Yazashné. The months that are exalted by holiness, the six Ghumbars (the feasts of the seasons, which are all named). The year, exalted by holiness, the chiefs that are great by holiness, the three and thirty that surround the "Howanim," that are shown by Hormuzd and communicated by Zurthost. [I cannot tell what these are; the translators apply this description to the thirty-three implements of the ceremonial]. The holy, high, and immortal angel "Meher" the king of cities, the stars, the bright star "Tester," the moon, and the glorious sun, rider of the fleet horse, created by God, and the ocean of light—all these I invoke or remember, and complete this Yazashné." All the angels of the thirty days of the month, of the twelve months, of the five "Gathas" (the intercalary days), are each then invoked by their respective names, in their order.

"The glorious fire, created by God, the water that is created by God, all the vegetable creation of God, the holy and high angel "Marespund," whose justice is not of the wicked "dews" (the evil spirits); such is also the justice of Zurthost—the long-enduring ways of the good Mazdiashná religion (religion of the worship of the almighty)—these I remember or invoke, and complete this Yazashné.

The holy mountain "Hoshdostar," created by God, all mountains created by God, the glory of the "Kayanian" kings of Persia, created by God, the glory of the holy priests, created by God, the good angel "Arsesung," of great intelligence and wisdom, glorious, and bestower of benefits, created by God, the virtuous, the good, prayerful, and holy men, and the angel "Daham," of high thought—all these I invoke or remember, and complete this Yazashné.

This place, and cities, and forests, and places of comfort, and water, and land, and trees, this whole earth, the sky, the holy wind, the stars, the moon, the sun, the God-created immeasurable light, all the holy angels, and all pure creation that is exalted by holiness, I remember or invoke, and complete this Yazashné.

The *Highest Lord*, who is all purity, the Lord of the days, of the months, of the year, of the Ghumbars, Him I invoke at this early dawn, and complete this Yazashné.

The holy and powerful departed soul of the "Poriodakesi," my own soul, all the angels of both worlds, created by God, who are exalted by their holiness, the five times of prayer of the day and their angels—all I invoke or remember."

This first "Hà" ends with the following prayer:—

"If I have by thought, word, or deed, intentionally or unintentionally, not kept thy commands, and thereby saddened thee, I invoke thee in this invocation, I pray to thee, and praise thee, and beseech thee for thy pardon."

A somewhat similar prayer is made to all the angels, and then follows;—I learn the Zurthosti religion, the worship of God, which is different from that of the dews (the evil spirits), and is like the justice of God.

In the above extracts, I have not repeated the words "I invoke," and "remember," as often as they do actually occur in the original, and I have said "I invoke or remember," by which I mean that all spiritual objects are invoked, and all material ones remembered.

The next five chapters are almost in the same strain and style, with several additions among the objects of invocation and remembrance, such as "light proceeding out of God himself, the soul of the prophet made an 'Izad' (angel) by God; God, the creator of all things, of light, the eternal, the omnipotent."

In the course of these six chapters, as also in many others,

God and the angels, and the various objects of creation, are addressed in various ways, such as "I love," "I honor," "I praise," "I remember," "Consider holy," "I gladden," "I invoke."

"Há 7.—I accept, and am glad to do deeds of virtue. May I receive the reward for piety through your bounty. O great and wise Lord, the reward that is due to the religious, may I and mine receive; that reward may thou give from thy stores of bounty in such a way, in this and the spiritual world, that I may be exalted; and may I live for ever and ever under thy all-holy leadership and all-virtuous protection. I understand "honwar" exalted, and truth-telling exalted. I praise the virtuous, the good, and the prayerful.

Há 8.—O God, in thy creation, those that are virtuous and follow thy commands, to them give thou water and fruit, and over all good things of this world, such as they desire, give them command. May the aspirations of the holy be fulfilled. May the wicked and the evil-doers be disappointed, and be swept away from the creation of the holy creator.

I, that is Zurthost, of the Hormuzdi and Zurthosti religion, I rise up before all the others, of the streets, and of the towns, and of the cities, and with highly good thoughts, highly good words, and highly good deeds, pray for freedom and ease to the community of holy men—to the wicked I pray for hardship and destruction."

Há 9 contains a dialogue between Zurthost and the angel Hom. I do not know what the duties of this angel are. He is described by Zurthost, in his personal interview with him, as the destroyer of death, and created holy. In reply to Zurthost's inquiries he names four persons who prayed to him, and obtained the desire of their prayers, in having sons born to them of glorious names and deeds. The four persons are, 1st. Vingham, the father of the great Jamshed, during whose reign there was no death. 2nd. Athwian, the father of the

great Faredoon, the vanquisher of Zohac, the tyrant and scourge of mankind. The 3rd, the warrior Sam, the father of the great hero, Kershasp, who destroyed the dragon, Sarronny, full of poison and destruction, and of the holy and pious Ornakhsh; and the 4th, Porosusp, the father of you holy and just Zurthost. Zurthost, then, praises him as exalted in the presence of the great God, by his virtuous and holy deeds, and prays to him to assist him in destroying all that is evil and wicked. and to bestow on him the power of doing good. "The first request I make, O Hom, the destroyer of death, is, may I attain the abode that is full of rest and glory, reserved for those that are holy. The second request I make of you, O Hom, the destroyer of death, is, may my present body enjoy good health. The third request I make, O Hom, the destroyer of death, is, may I live a long life. The fourth virtue I ask from you, O Hom, the destroyer of death, is, may I do like those, who, with courage and gladness, pursue, in this world, the path of righteousness, and destroy whatever is evil. The fifth virtue I ask, O Hom, the destroyer of death, is, may I do as those brave men, who, in battle, fight gloriously to destroy oppression and wickedness. The sixth virtue I ask from you, O Hom, the destroyer of death, is, may I know, beforehand, the intrigues of the enemies, the attack of the thieves and the wolves; teach me to thwart the evil designs of the wicked, the impious, and the deceiver."

Hom is then described as the inspirer of courage and strength in the warrior and his steed; the bestower of children and good husbands, the inspirer of wisdom to the student of learning, the disappointer of those rulers who wish destruction to the worshippers of God, the just, the distinguisher of good from evil, &c. "The king and the 'durwesh' of good conscience are equal before your eyes."

The 10th and 11th Há are also in praise and description of the power and duties of Hom. In one place, the person

praying, or Hom, I cannot tell which, says—"I am among those of virtuous thoughts, and not among those of wicked thoughts. I am among those of virtuous words, and not among those of wicked words. I am among those of virtuous deeds, and not among those of wicked deeds. I am among the obedient performers of God's commands, and not among the disobedient. I am among the holy men, and not among the sinful.

12th Há, in which, as in several other places, is enjoined to protect and take care of the helpless sheep; and after a general prayer for the good and against the wicked, ends thus—"I (the person praying) am of the religion of "the worship of God." I praise that religion, and declare it before the wicked, and praise it with good conscience, virtuous words, and virtuous deeds," &c.

From the 12th to the 18th Há, are invocations and acknowledgements of the power and goodness of God, the greater and smaller angels, all things spiritual and material in creation, the thirty angels of the days of the month, &c., &c., as in the first seven Hás.

From the 19th Há, I give more extracts: Zurthost asks God—"Tell me, O great invisible God, the creator and promoter of all creation, what were thy words before the existence of the heavens, before the waters, the world, the harmless sheep and other animals, before the trees, before the glorious fire, created by thee, O Hormuzd, before the holy man, before the wicked spirits of dull reason, before all thy creations in the world, and before all the good and holy things created by thee—what were thy words?" God replies thus—"O supentaman Zurthost, those words were the parts of "Honwar"—those that I have told you; these were my words before the heavens, before the waters," &c., &c. [The parts of the "Honwar" are explained by the translator to mean the twenty-one books or parts of the religion of God, promulgated by Zoroaster.]

"O supentaman, whoever shall learn or repeat, without wearying, these parts of "Honwar," shall attain a hundred times greater superiority than by learning or repeating any other holy words. Him shall I pass over the "Chinwad Púl" (the bridge in heaven over which the souls pass on the fourth morning after death), and admit him to the paradise of the holy that is full of glory. Whoever shall forget these holy words shall have his soul kept at a distance from the glorious paradise, at the same distance at which his soul shall be from his body, at a distance of the whole length of the world. Before I created the heavens, before the waters, &c., I created Khurshed (the sun) to give light to the universe. The great body of the holy men that have been, that are, and that will be, is so holy on account of obeying the commands of God, and having done other good deeds. Whoever shall study and meditate much upon the words of the "Honwar," and recollect them, and act according to them, after death shall attain to everlasting exaltation. All the days of the holy man are with thoughts of truth, words of truth, and deeds of truth. The high priest is he who is learned in the religion, and whose whole life is devoted to the promotion of righteousness in the world.

Há 20.—Whoever tastes the pleasure of righteousness, which is above all other pleasures, and walks in righteousness, shall be perfectly holy; he is virtuous, who walks in virtue among the holy men, and is true to them.

Há 24.—The righteous are immortal.

Há 30.—He who knows God through His works reaches Him.

Há 31.—Zurthost asks—'What is the reward to the holy and good from your bounty, and what is to become of the heathen and the wicked?' Hormuzd replied—'On the day of reckoning the wicked shall be destroyed (I am not quite sure of the word which I have translated destroyed); those

that are hostile to the virtuous—to the harmless animals and men—those that tell untruths and do wicked actions, shall not receive the reward of life from Hormuzd. He only shall receive the reward, at the time of reckoning, who in his heart believes in God, and does not injure the promoters of holiness. To speak true words is true excellence. He who leads the holy man astray, there is bewailing and moaning for his soul after death, and for a long time his soul has to live in the abode of darkness, to suffer great hardships—that dark abode which is for the wicked; your evil deeds shall draw you to it.'

Há 33.—Zurthost says—'The wicked are punished according to their thoughts, and words, and deeds. Better it is that they be introduced to a taste of learning. O Hormuzd! give them a desire for wisdom, that they may become the promoters of holiness. Give me, O Hormuzd, the two desires, to see and to self-question.'

Há 34.—'O Hormuzd, I worship thee, and in the heavens, also, I shall worship thee much. What, O Hormuzd, is thy will, what thy worship, and what is thy invocation?' God replies—'See and adorn holiness—learn my ways of holiness with a good conscience.' 'Tell me, O Hormuzd, the ways of good conscience.' 'To be glad with the religion of the good, with virtuous deeds, and with holiness.'

'For holiness and purity, I ask the aid of Ardibeshest (angel of fire); for pure thoughts, I ask the aid of Bahaman, and I ask Sharevar's aid. I worship thee, O Hormuzd, above all others—I invoke thee above all others. All virtuous thoughts, all virtuous words, and all virtuous works flow from thee. O Hormuzd, I invoke thy pure nature, above all others.'

'By my deeds may I (says Zurthost) exalt and honour thy name. Under the protection of thy great wisdom have I acquired wisdom; may I reach thee; may I always be firm in thy friendship, and in holy deeds.'"

Há 44 contains a series of questions from Zurthost to God,

among which occur the following, and in which the interrogation implies the reply—"If not thou:"—

"O wise Hormuzd, I ask of thee, what is the greatest exaltation in this world? How can any, who wishes benefit to himself, be holy, promote virtue, be the beloved of Hormuzd among the creations. O wise Hormuzd, I ask, who is the creator and promoter of holiness? How have the revolutions of the sun and moon been created? How does the moon wax and wane? O Hormuzd, give me the knowledge of these? O Hormuzd, I ask, who has made the earth stand unsupported? Who has created the waters and the trees? Who has created the air which flows of itself with such force? Who has created Bahaman? Who has created the receiving of light and of darkness? Who has created the times of the day, and the time of reckoning and judgment? Who has created the desire to be exalted through virtuous thoughts? Who has created the affection that the child receives from the father? O Hormuzd, I hope more from thee than from all others. Thou art the promoter of all goodness—the holy Hormuzd—Thou art the creator of all creation.

Say to me—How may my soul attain to the gladness of both worlds? How may I impart purity to this religion—that the virtuous and wise may learn greatness, and Bahaman (good conscience), and Ardebehest (high virtue), enter their hearts and abide there; and, in the treasures of religion, exalt truth above all?

What is the high religion? The reply—That which promotes my holiness and truth with good thought, word, and deed.

O Hormuzd, give me thy wisdom and treasure that I may rejoice. O wise Hormuzd, whoever is holy questions himself; whoever is wicked rejects this my religion that benefits. How do the evil-disposed suffer annihilation, who do not subject themselves to self-reflection through Bahaman (good

conscience)? When is the time of resurrection and final judgment? How can one deserve the reward of ten young horses and camels? Thou gavest to Khordad and Amardad this reward—this reward thou givest to the truth-speaker. Who are those sinners whose end is destruction? O Hormuzd, why may not these sinners become virtuous? Who will destroy them? The reward of the unholy, of the deceivers, of the outragers of justice, and the destroyers of the harmless animals, shall not be like that of the holy and virtuous.

Há 45.—To those that are conscientiously religious, and are promoters of religion, God is friend, brother, and father.

Há 46.—May all men and women of the world become my followers, and become acquainted with thy exalted religion, that I may rise in thy praise and in thy religion with prayer; and pray with a pure conscience.

Whoever accepts Zurthost's religion, praises it, and meditates on it, and studies it much, to him God gives a place in the other world, and in this world Bahaman (good conscience) gives him exaltation. Sinners of wicked thoughts, wicked words, and wicked deeds, of wicked doctrines, have to their souls presented bitter and detestable food in that well-known and permanent house of the wicked spirits.

Há 51.—I bless all good men and women that have been, that are, and that shall be. May they enjoy for ever and ever the invisible treasure, according to their desire. May water, and sheep, and vegetation, afford all comfort to them. May the inflictions of evil spirits and evil men never approach them.

Há 55.—O Mazdiashnans! desire to invoke the pure Surosh."

This Surosh is described to be the guardian and protecting angel of this world. He protects men from the evil spirits of hell, and of Màzandaran, from all that is evil, anger, and injustice, &c.

"Há 56.—I invoke the benefit and success of prayer: to arrive at prayer is to arrive at a perfect conscience : the good seed of prayer is virtuous conscience, virtuous words, and virtuous deeds. May our prayer be efficacious in thwarting the inflictions of wicked spirits and wicked men. May I love prayer to Hormuzd, for that prayer is joy to me. I resort to prayer, I invoke prayer. Prayer to thee, O Hormuzd, is the giver of excellence, holiness, success, and high exaltation—it is the act of virtue. May the fold (of sheep) of the people of this street not diminish—may virtue not diminish—may the strength of the holy men not diminish—may not Hormuzd's justice diminish—may the good and exalted holy souls arrive here—may the virtue of the virtuous endure, and may wickedness vanish. In this house—may obedience prevail over disobedience, peace over quarrels, charity over hard-heartedness, good thoughts over bad thoughts, words of truth over words of lie, piety over sin.

Há 59.—I enjoin on earth, and in heaven to study the "Honwar." I enjoin holiness on earth and in heaven; that to pray much to Hormuzd is good, I enjoin in heaven and on earth. I enjoin the holy and the virtuous, and the prayerful, on earth and in heaven, to punish the evil spirit and his works, which are wicked and full of death—to punish the thief and the tyrant—punish the magicians of cruel intentions—punish the breakers of promise, and those that induce others to break their promise—to punish the harassers of good and holy men —to punish the evil thoughts, words, and deeds of the sinful."

Hás 62 to 64.—The angels of fire and water, and other angels are prayed to for several sorts of benefits and blessings; among others, a son who would help and protect him, and be a worthy man—who would not wish ill to anybody—who would not hurt anybody with any arms—who would not seek revenge, nor do harm.

I now arrange some of these extracts under different heads,

as inferences derived from them. To avoid repetition, I shall not, under each head, give all the texts corroborative of it.

The Parsees believe in only one God, the creator of all.

"1st Há.—The great judge, Hormuzd, of glory and brightness, the highest, the all-virtuous, the greatest, strictest, the all-wise, of the purest nature, the holiest, lover of gladness—the invisible to the invisible, the increaser—He created our soul—He moulded our body—He gave us existence. Há 34.—I worship thee, O Hormuzd, above all others, I invoke thee above all others, all virtuous thoughts, all virtuous words, and all virtuous works, flow from thee. O Hormuzd, I invoke thy pure nature above all others. By my deeds may I exalt and honour thy name. Under the protection of thy great wisdom have I acquired wisdom. May I reach thee. May I always be firm in thy friendship and in holy deeds."

In Há 44 several extracts relate to this subject, especially God as the creator of all, ending in "Thou art the Creator of all Creation."

In a prayer to Hormuzd (Hormuzd Yasht) occurs this—"My name is the Creator of all."

Zurthost worships God not only in this world, but in the heavens also—Ha 34, "O Hormuzd, I worship thee, and in the heavens, also, shall I worship thee much."

The Parsees believe in the existence of angels, created by God, with powers to aid and benefit mankind in various ways, and to be the superintending spirits of the various parts of creation. The chief among these are the angels of good conscience (Bahaman), and of high piety (Ardebehsht); the former is also the protecting angel of the harmless animals, and the latter the angel of fire.

"1st Ha.—I Invoke good conscience, high piety, love of excellence, high and perfect thought, Khordad and Amardad; all other angels that reach us; the angel "Meher," the lord

and guardian of the forest, of thousand ears and ten thousand eyes, of gladness and of comfort." Many other extracts can be made to deduce the above inference.

The various parts of creation are praised, or remembered, or considered holy, &c.

The first seven Hás contain many texts illustrative of this.

"The fire created by God, the time of day, the early dawn, the waters created by God, the year that is spent in holiness, the moon and the glorious sun, the ocean of light, the stars, the immeasurable light, the mountains and the trees, the forest, the sheep, and the harmless animals;" in short, nature, in her various parts and phenonena, is sometimes praised, sometimes remembered, sometimes described as holy.

As far as I have seen, there is no text in which any lifeless material object without intelligence or spirituality is invoked for assistance or benefit. Such prayers are always directed to intelligent spirits or angels, and to God above all, and as the Creator and Lord of all.

The Parsee believes in the immortality of the soul, and in rewards and punishments after death.

"Hà 7.—O great and wise Lord, the reward that is due to the religious, may I and mine receive; that reward mayst thou give from thy stores of bounty in such a way, in this and the spiritual world, that I may be exalted, and may I live for ever and ever under thy all-holy leadership, and all-virtuous protection.

Há 8.—May the aspirations of the holy be fulfilled, may the wicked and evil-doers be disappointed, and be swept away from the creation of the holy creator. The righteous are immortal."

Extracts from Há 31 bear on this point.

Notwithstanding the abhorence of evil and evil-doers, the Parsee is made to wish that the wicked may be converted to virtue.

"Há 33.—The wicked are punished according to their thoughts, and words, and deeds. Better it be that they be introduced to a taste of learning. O Hormuzd, give them a desire for wisdom, that they may become promoters of holiness.

Há 44.—O Hormuzd, why may not these sinners become virtuous."

The Parsee rests his pardon on the mercy of God, and his reward on the bounty of God.

"Há 1.—If I have by thought, word, or deed, intentionally or unintentionally, not kept thy commands, and thereby saddened thee, I invoke thee in this invocation, I pray to thee and praise thee, and beseech thee for thy pardon.

Há 7.—May I receive the reward for piety through your bounty."

The morality of this religion is comprised in the three words, pure-thought, pure-word, and pure-deed; and holiness, virtue, prayers, &c., are praised and exalted, and inculcated in many places.

"Há 7.—I praise the virtuous, the good, and the prayerful.

Há 19.—The high-priest is he who is learned in the religion, and whose whole life is devoted to the promotion of righteousness in the world.

Há 20.—Whoever tastes the pleasure of righteousness, which is above all other pleasures, and walks in righteousness, shall be perfectly holy. He is virtuous who walks in virtue among holy men, and is true to them.

Há 34.—What, O Hormuzd, is thy will, what thy worship, and what thy invocation? God replies—See and adorn holiness—learn my ways of holiness with a good conscience. —Tell me, O Hormuzd, the ways of good conscience.—To be glad with the religion of the good, with virtuous deeds, and with holiness.

Há 56.—May the virtue of the virtuous endure, and may

wickedness vanish. In this house, may obedience prevail over disobedience, peace over quarrel, charity over hard-heartedness, good thoughts over bad thoughts, truth over words of lie, and piety over sin.

Hà 59.—I enjoin on earth and in heaven to study the "Honwar." I enjoin holiness on earth and in heaven. That to pray much to Hormuzd is good, I enjoin in heaven and on earth. I enjoin the holy, and the virtuous, and the prayerful, on earth and in heaven, to punish the evil spirit and his works, which are wicked and full of death—to punish the thief and the tyrant—punish the magicians of cruel intentions—to punish the breakers of promise, and those that induce others to break their promise—to punish the harassers of good and holy men—to punish the evil thoughts, words, and deeds of the sinful."

Truth is particularly inculcated.

"Há 7.—I understand truth-telling exalted.

Há 19.—All the days of the holy man are with thoughts of truth, words of truth, and deeds of truth.

Há 31.—To speak true words is true excellence."

The Parsee believes in the necessity and efficacy of prayer.

"Há 56.—I invoke the benefit and success of prayer. To arrive at prayer is to arrive at a perfect conscience; the good seed of prayer is virtuous conscience, virtuous words, and virtuous deeds. May our prayers be efficacious in thwarting the inflictions of the wicked spirits and wicked men. May I love prayer, O Hormuzd, for prayer is joy to me. I resort to prayer, and I invoke prayer. Prayer to thee, O Hormuzd, is the giver of excellence, holiness, success, and high exaltation; it is the act of virtue.

Há 59.—To pray much to Hormuzd is good, I enjoin in heaven and on earth."

The study of the religion is considered most meritorious; and the holy word (the Zend Avestá) is said to have been

created by God before all creation. Extracts from Há 19 all refer to this subject.

"Há 44.—What is the high religion? That which promotes holiness and truth with good thought, word, and deed.

Há 19 declares "Honwar" (the word of God) to have been created before the heavens, before the waters, before all creation; and that whoever studies them without wearying shall attain to the paradise of the holy, which is full of glory.

Há 59.—I enjoin on earth and in heaven to study the Honwar.

The Parsee religion is for all, and not for any particular nation or people.

"Há 46.—May all men and women of the world become my followers, and become acquainted with thy exalted religion. Whoever accepts Zurthost's religion, praises it, and meditates on it, and studies it much, to him God gives a place in the other world; and in this world Bahaman (good conscience) gives him exaltation."

The Parsee religion contains no propitiating of the devil. There is not a single reference to the thoughts, or words, or deeds of evil spirits, without wishing destruction or reformation to them.

"Há 1.—I learn the Zurthosti religion, the worship of God, which is different to that of the Dews (the evil spirits), and is like the justice of God.

Há 8.—May the wicked and the evil-doers be disappointed, and be swept away from the creation of the holy Creator.

Há 12.—I am of the religion of the worship of God, I praise that religion and declare it before the wicked, and praise it with good conscience, and virtuous words, and virtuous deeds.

Há 44.—O Hormuzd, why may not these sinners become virtuous?

Há 33.—The wicked are punished according to their thoughts, words, and deeds. Better it be that they be introduced to a taste of learning. O Hormuzd, give them a desire for wisdom, that they may become promoters of holiness."

The Parsees are called by others, "Fire Worshippers," and they defend themselves by saying that they do not worship the fire, but regard it and other great natural phenomena and objects as emblems of the divine power. To me it appears that the imputation, on the one hand, is wrong, and the defence, on the other hand, a little overshot. Though the Parsee "remembers, praises, loves, or regards holy," whatever is beautiful, or wonderful, or harmless, or useful in nature, he never asks from an unintelligent material object, assistance or benefit; he is, therefore, no idolator, or worshipper of matter. On the other hand, when the Parsee addresses his prayers to Hormuzd, or God, he never thinks it at all necessary that he should turn his face to any particular object. He would say, and does say, his "Hormuzd yasht" (prayer to Hormuzd) anywhere whatever without the slightest misgiving. Again, when he addresses the angel of water, or any other but that of fire, he does not stand before the fire. It is only when he addresses the angel of fire that he turns his face to the fire. In short, in addressing any particular angel, he turns his face to the object of that angel's guardianship as his emblem. But, in his prayers to Hormuzd, he recognises, or uses, or turns his face to no emblems whatever. Since fire only could be brought within the limits of a temple—any of the grand objects of nature (as the sea, the sun, &c.) being unavailable for this purpose—the temples naturally became the sanctuaries of fire alone, and hence has arisen the mistake of the Parsees being regarded as "Fire Worshippers."

This much is clear in Ha 30—"He who knows God through his works reaches him;" but I do not recollect meeting with any text enjoining a Parsee to turn his face to any particular object as an emblem of God; though he is directed, as in the above text, to rise from Nature to Nature's God.

I do not recollect meeting with a text, that "the Evil Spirit is cöeval with God." In one place, Há 19, all wicked spirits are spoken of as having come into existence after a certain

event—"Tell me, O great invisible God, the creator and promoter of all creation, what were thy words before the existence of the heavens, before the waters, * * before the wicked spirits of dull reason, before all creation," &c. Whether these wicked spirits include or not the well-known Harimàn among them, I cannot tell. It is generally supposed that Hormuzd and Harimàn are good and evil principles. I do not think that I have met with any text that supports this theory, as far as Hormuzd is concerned, or in which the good principle is personified. Hormuzd is distinctly "The intelligent living Creator," as far as I can gather, and not a mere personification of the principle of good—a Creator distinct from his creation, either material, moral, intellectual, or spiritual.

In the Yazashné, scarcely once even is Harimàn mentioned. Harimàn, not by this very name, but by the name of Angare Meniús is mentioned in the Vandidad as having, to thwart Hormuzd's good works, produced several evils. This Angare Meniús is rendered in the Gujarati translation, Gana Minó, which, I think, means "the sinning angel," though I am not quite sure of it. I am not at present able to say more about the age, or nature, or meaning of Harimàn; but one thing is clear, that evil will have an end.

"Há 31.—On the day of reckoning all the wicked shall be annihilated."

At the end of the Yazashné is given a list of God's one hundred and one names. Whether all have their authority in the Avestá I cannot say. Among them occur the following—The Almighty, Omniscient, Omnipresent, the Lord of the Universe; without beginning and without end: the beginning of all—the end of all; the greatest, without a like, without rival, &c.

The language of these one hundred and one names, as far as I can judge, from my limited knowledge of the modern Persian, is not Zend.

These extracts are, I think, sufficient to give a general idea of the character and doctrines of the Parsee religion; but it must be remembered that I am not well qualified to speak with any authority on the subject. I have received at third hand the extracts I have given The original Zend is translated into Pehlvi, from the Gujarati translation of which I have given in English. This Gujarati translation is considered rather imperfect, and in several places it is so confused that I have omitted giving some more extracts, simply because they are ambiguous or unintelligible.

I have avoided giving any opinion on, or discussing any of the doctrines. I give the extracts as faithfully as my hurried reading has permitted, leaving it to the reader to draw his own conclusions.

Besides the Yazashné, from which the preceding extracts are given, there are only three or four other books considered by the Parsees as a portion of their original religious books.

But Priestcraft acting upon ignorance has not failed to do its usual work, and has left a legacy of a few books which the Parsee has no reason to be thankful for. Many ceremonies and notions have thus been introduced, and the reformers of the day contend that all those ceremonies and notions that have no authority in the original Zend Avestá ought to be abolished and disavowed. Of course the old orthodox Parsees and the Priests do not like this at all.

When I read the Old Testament many years ago, I was very much struck with parts here and there that almost described the present belief and practices of the Parsees. I have not had time at present to go over the whole book again, but I just turned over its pages to select some of these passages.

I do not know whether the offering of sacrifices is an institution in the Parsee religion—it is not the present practice. Chapter XI of Leviticus concerning what beasts may, and what

beasts may not be eaten, what fishes, what fowls, and what creeping things are unclean; the command to wash the clothes in touching the dead carcases of unclean animals, to break the earthen vessel, and consider everything touched as defiled, &c., may be taken as a fair description of what the orthodox Parsees at present believe and observe. This belief being now rather traditional, I do not know whether it goes into the details of the unclean and clean animals, as in verses 13 to 22.

Chapter 12 on the purification of women after child-birth, with the exception of the circumcision, of the three-score and six days for the purification of blood on the birth of a daughter, (which is also 40 days among the Parsees,) and the offerings, is almost all applicable to the Parsees.

Chapter XV on the uncleanliness of men and women in their issues, and cleansing them, with the exception of being unclean until the even, and the offerings, is applicable to the Parsees, and is of present observance among them.

Chapter XVIII on unlawful marriages and lusts is observed by the Parsees; marriage among cousins is recommended, and the Parsees are entirely monogamists. I have an impression that among the Parsees there is an ordinance by which a man of blemish is not allowed to become a ministering priest.

In the Book of Psalms there are passages which strike as similar to the extracts given before from the Yazashné.

At the commencement I gave some account of the present imperfect knowledge of the Parsees about their own religion, I do not however mean to blame them much for it. A handful of persecuted exiles living in a foreign land, surrounded for 1200 years by idolatry, and persecuted at times by religious fanaticism, it is rather a matter of surprise, as with the Jews, that the Parsees have preserved their national type and character, and their original worship. Though they have not altogether escaped contamination, and have adopted many

superstitious ceremonies and notions of the Hindoos, they have always recoiled from degenerating to the worship of idols, and have tenaciously clung to the idea that they were worshippers of the invisible Hormuzd. Believing in the existence of Angels and their delegated power to assist and benefit man, the Parsee centres his prayers and his hopes above all, on Hormuzd, the Lord of the Spirits; his whole morality is comprised in three words—pure thought, pure words, and pure deeds; his reward depends upon his fulfilment of these injunctions, and his pardon on the will and mercy of God.

Mr. Dadabhai said that no member need feel any delicacy in putting any question to him on the subject of the paper, for he would be very happy to answer them.

Dr. Ihne said he had brought with him a French work, by M. Ménant, containing an excellent digest of the Parsee Creed, which, according to it, was briefly as follows:—"There is one God, He is eternal, there was nothing before Him, and all things are by Him. The universe was *truly* created by Him, and is not an emanation from Him, but, since the creation, has been distinct from the Creator. Creation is composed of spirits and matter. Matter is inert, but spirits are capable of morality. The world of spirits is double. Hormuzd is chief of the spirits of good, for eternity. Ahrimán is chief of the spirits of evil, only for time which passes. Both were created by the Eternal, and will endure for the eternity which follows. Souls are all sisters from the beginning, deprived of the body at death, to find it again at the hour of resurrection, then never to be separated from it again—they were eternally pre-existent. The guilty will be punished, the just rewarded—both by God. Punishment will only last as long as the principle of evil (Ahrimán) endures. The Zend authority is from God, and dogmatic. Hormuzd established religion for all mankind, and not for some only. It will be one day preferred by all mankind, and thus be universal both as to time and space." This creed, it is to be observed, is derived from the sacred books, and not from the present belief of the Parsees.

The Rev. C. D. Ginsburg said that, having read a German translation of the Zend Avestá, it agreed with the summary Dr. Ihne had read. He remarked that some of their doctrines were also believed by the Jewish sect of Cabbalists. No other people (except the Jews) believed in the resurrection of the body. In the Zend Avestá it was affirmed that both the principles of good and evil were created by the Great Existence, and were not eternally pre-existent, and that every man has both these principles reflected in him.

Mr. Dadabhai said that the creed, as given by Ménant, is derivable from all the extracts he had read, with the exception of the question of the origin of Hormuzd and Ahrimán. That given by M. Ménant is the prevalent theory; but, as far as his reading of the Gujarati translation of the original Zend text went, he had not been able to confirm the story of the creation of Hormuzd and Ahrimán by Time without bounds (Zurwan Akarné), which implied that they were eternal only for *future* time; but he would not speak with confidence on this point.

Mr. Clark observed that in Guizot's edition of *Gibbon's History*, the original principle is called *Time Without Bounds*, and existed from all eternity. The two created principles were both good at first, but Ahrimán became apostate. There were many analogies in the Zend books with the early books of the Bible; for example, an institution is mentioned identical with that of tithes. The ancient Persian religion was one of forms and ceremonies, but that of Zoroaster rather one of morality.

Dr. Collingwood said: We are indebted to the well-known enlightenment and liberality which distinguish the Parsees in general, and my friend Mr. Dadabhai in an especial manner, for the very interesting exposition we have heard of the received doctrines of their religion; and we are, moreover, freely invited to discuss the subject. Mr. Dadabhai stands before us not as a Parsee defending his faith, but simply as a member of this society giving an unvarnished account of what he finds in his sacred books, unencumbered by any theory of his own. But the Zend Avestá also contained much more of an apparently fabulous nature, upon which I would wish to make some remarks. There is a remarkable similarity traceable between all the religions existing before the Christian era, which, I believe, arises from the fact that all those religions, excepting the Jewish, were originally of a purely astronomical origin. Man is in all ages religious, and, as I formerly showed at some length before this society, the heavenly bodies received his first and earliest worship; and the religion of Zaratosht was derived from the prevailing forms of worship. At a very early period the *origin of evil* was a question which agitated mankind. Whence *good* comes, says one, we know—but whence is evil? It cannot come from heaven—for, it is not possible that the same being, whether good or bad, can be the author of both. Hence arose the necessity of supposing two principles always opposing one another. These principles were early associated with physical phenomena. *Light* was good—*darkness* evil; *summer* was the distributor of benefits, which *winter* was always undoing and destroying. But it was the Sun which produced light, and covered the earth with verdure in summer, and his absence which bound it up in winter; and thus this luminary became early personified as the great principle of good, and his struggles and alternate mastery over, and conquest by, the evil principle, were symbolically described in the battles of the gods and giants—of Ouranos and Typhon, of Osiris and Typhon, of Hormuzd

and Ahrimán. The very name of Hormuzd signified, according to the best authorities, *the great principle of light;* and the astronomical character of the early Persian fables may be illustrated by one incorporated in the Zend Avestá. Hormuzd made six deities, which represented virtues; whereupon, Ahrimán made six of a malevolent nature. Hormuzd raised himself three times higher than his wont, and decorated the heavens with stars, appointing Sirius sentinel over them. Again, Hormuzd created twenty-four gods, which (says the fable) he enclosed in an egg. Ahrimán did the same, and these broke the first egg, and thus good and evil became intermixed. Now, all this evidently relates to the constellations—the six good deities were symbolical of the six zodiacal signs, between the vernal and autumnal equinoxes, when the sun was in power. The six evil ones were, of course, the six winter signs. Hormuzd raising himself three times his height above the earth, meant his elevation above the spheres of Mars, Jupiter, and Saturn, which would bring him to the pure ether—the region of the stars. The twenty-four gods were the twenty-four northern constellations, six zodiacal and eighteen extra-zodiacal; for, before Hevelius formed constellations from the *stellæ informes* there were but eighteen constellations in either hemisphere. And the twenty-four gods of Ahrimán were, of course, the remaining twenty-four southern or winter constellations. The equinoxes showed the term of duration of power of these great opposing principles; and whether we regard the Persian statues of the bull (Taurus, the vernal equinox) being destroyed by the scorpion (Scorpio, the autumnal equinox), or the fable of Jupiter (the sun of summer) losing his thunderbolt (power, vigour) in winter, as related in the Dionysiac of Nonnus, the meaning is the same. The sun, indeed, was personified with different attributes, according to his position in the zodiac. Thus, the vernal sun was the beardless, youthful Apollo; the autumnal, the bearded, aged Æsculapius, son of Apollo, with a serpent twisted round his staff, or even round himself. This serpent was the great serpent of the heavens, which stretched its length beside the three autumnal constellations of Libra, Scorpio, and Sagittarius, and into whose folds the sun appeared to descend in autumn. Hence the explanation of the well-known mythical Hindoo figures of Vishnu, *conquered* (in autumn), enveloped in the folds of the serpent, and *triumphant* (in spring), with the serpent raised aloft in his arms. And thus we can understand the enigma uttered by the oracle of Apollo at Claros, in Ionia, which said "I am Jupiter Ammon in spring, and black Pluto in winter."

Dr. IHNE said, the astronomical explanation might be very well applicable to the religion which prevailed before Zoroaster as it was to other ancient religions, but that introduced by him was entirely spiritual and moral—that he may have retained some of the institutions of the old faith, but the peculiar characteristic of the Zoroastrian faith was its

spirituality and high morality, as must have been seen from the extracts read.

Dr. Collingwood replied that he by no means intended to imply that it was not so, and he was glad that Dr. Ihne had given him an opportunity of making himself better understood. The religion of Zoroaster was singularly refined and purified from the more ancient grossness.

The Rev. C. D. Ginsburg agreed with Dr. Collingwood in the astronomical nature of the ancient religions.

In answer to questions from various members, Mr. Dadabhai said the Parsees were at present, to some extent, fatalists; but this was one of the corruptions which had crept in through their intercourse with the Hindoos. They were monogamous; and their sacred books did not degrade woman below man, though it was only lately that their women had been allowed to mix in society. With regard to the *worship of fire*, which was brought against them, they regarded fire as the purest and best symbol of the Deity, and that one of His works which could be most conveniently isolated and circumscribed; hence, they had sacred fires in the temples, towards which they turned when addressing their prayers—not to it, but to the god of which it was the symbol. The injunction is to turn their face to anything that is glorious, as the sea, the sun, &c. Such is the explanation often given by the Parsees. I have given, however, in the body of the paper what appears to me to be the true state of the case. They would not abuse fire, nor extinguish it unnecessarily, nor use it in a contemptuous manner. Hence, the Parsees do not smoke. Their estimation of all other natural objects, such as water, trees, &c., being quite equal to that for fire, they would not do anything which they consider as abuse or defilement of them; also, they would never spit, nor throw any dirty thing upon them.

The President, in conclusion, said that the interesting paper and discussion they had heard more and more convinced him that God was not without witnesses in all countries and in all ages. He called upon the society to give an unanimous vote of thanks to Mr. Dadabhai, which was carried by acclamation.

TWELFTH ORDINARY MEETING.

Royal Institution, 1st April, 1861.

The Rev. H. H. HIGGINS, M.A., President, in the Chair.

Mr. George Melly was elected a member.

The Secretary read several letters from scientific societies in London and elsewhere, in which promises were made to send their Proceedings to the Literary and Philosophical Society in future.

Mr. Morton exhibited various fossils from the neighbourhood of Prescot and St. Helens, consisting of Lepidodendron, Sigillaria, Calamites, Anthrocosia robustus, scales and teeth of fishes, &c.

Dr. Collingwood read some passages from a private letter from Mr. Darwin, in which that gentleman expressed himself with regard to the theory of natural selection in a manner which could not fail to remove much of the prejuidice and and hostility generally maintained against his views.

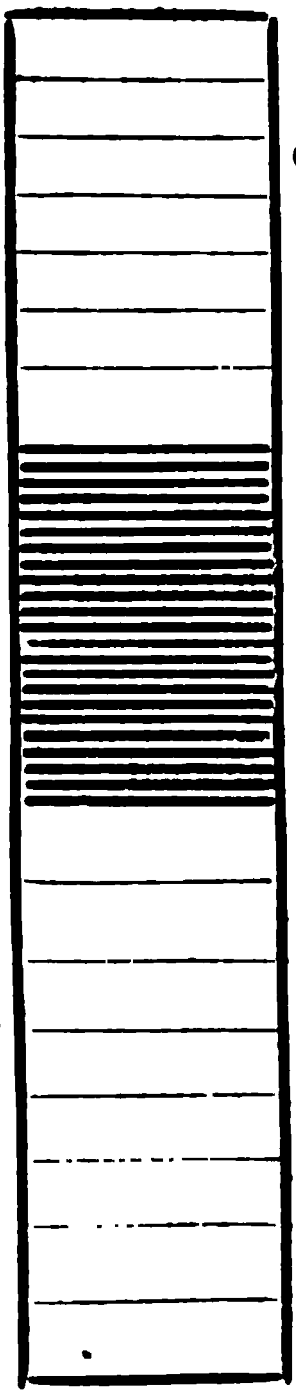
The following paper was then read—

ON THE COAL MEASURES IN THE NEIGHBOURHOOD OF LIVERPOOL, AND THE PROBABILITY OF THEIR EXTENSION BENEATH THE TOWN.

By G. H. MORTON, F.G.S.

The survey of the country around Liverpool having been completed by the Government Geologists, we are in possession of all the materials necessary to present a concise notice of the Coal-measures developed in the district.

A line of section, north and south, with Prescot as the centre, is, perhaps, the most interesting, on account of its showing the whole series of coal strata, and being the nearest workable coal-field. The general succession of the strata is as follows:—



Upper Coal-Measures, south of Huyton, 1500 feet. — Grey and brown Sandstones, Shales, Red and Mottled Marls, with thin seams of Coal.

Middle Coal-Measures, Huyton and Prescot, 1300 feet. — Sandstones and Shales, containing fourteen workable beds of Coal.

Lower Coal-Measures, Knowsley. 2000 feet. — Gannister Series, Sandstones, and Shales, with thin Seams of Coal.

The Coal-seams of Prescot are all represented at St. Helens, but two-thirds of them are known by different names. They are co-ordinate in the "Memoirs of the Geological Survey of Great Britain." * The Coal-beds are more distant from each other at St. Helens than at Prescot; while at Wigan, they are still further expanded by the greater thickness of the intervening measures.

The *Upper Coal-Measures* consist of all the strata between the "Felcroft Coal," and the "New Red Sandstone." This sub-division consists of grey and brown sandstones, shales, and peculiar red and mottled marls, which (at Sutton, to the east of the section), contains casts of Modiola Macadami. There are several thin partings of Coal, one of which may be seen in Burrows' lane, near Sutton. North of Tarbock Hall, the series is overlapped by the "Lower Bunter Formation." No satisfactory section, showing this overlap, is seen, but it is inferred from the two formations being present close together, without any apparent fault. However, at Ashton's Green Colliery, near Sutton, the overlap has been proved by a shaft passing through sixteen yards of the Lower Bunter into the Coal-measures.

The *Middle Coal-Measures.* This is the series in which all the profitable beds occur. The fourteen workable coal-seams have an united thickness of sixty-one feet, and are divided as follows :—

		Ft.	in.
1	Felcroft Coal	7	0
2	Pastures Coal............	4	6
3	Discoverer Coal	3	0
4	Yard Mine Coal.........	3	2
5	Cannel Mine Coal	5	9
6	Higher Bag Coal	6	6
7	Lower Bag Coal.........	3	6
8	Cheshire Coal............	2	3
9	Tenlands Coal	0	0
10	Bastions Coal............	4	0
11	Sir John Coal............	3	4
12	Prescot Main Coal......	10	0
13	Rushey Park Coal......	5	0
14	Little Delf Coal	3	0
		61	0

* The Geology of the Country around Prescot, by Edward Hull, A.B., F.G.S.

The thickness of the Middle Coal Series at Prescot is 1318 feet, including the 61 feet of Coal-seams above two feet thick. At St. Helens, the same sub-division is 1775 feet thick, containing 83 feet 8 inches of Coal; while at Wigan, it is 2188 feet, with 70 feet 7 inches of Coal.

I am not aware that the fossils of the Coal-measures, near Liverpool, have ever been collected together, though there is little doubt they would repay the trouble of a proper search.

In the Prescot district, at Halshead, the shales associated with the Upper Coals consist of hardened bluish mud, crowded with the remains of Calamites and their Spikelets. Sigillaria and Lepidodendron, seem to be common in the lower part of the series. However, as these genera of plants contribute mainly to the formation of Coal, their occurrence is common to all Coal-fields. Impressions of ferns are seldom to be obtained, but fish fragments, scales, teeth, and bone-plates, are common in strata associated with the Rushey Park Coal-seam. They belong to the genera Gyrolepis, Platysomus, and Cœlacanthus. Anthrocosia robustus occurs above the Ravenshead and Rushey Park coals. This shell, formerly considered to be an Unio, is now thought to be a marine, or brackish water species, from having been found lately, associated with Modiola and other marine shells. At Whiston, there is a bed of limestone four feet thick, with Microconchus carbonarius.

The *Lower Coal-Measures*, or "Gannister Series," extends from Huyton Quarry to the north of Knowsley. The Huyton sandstones are the upper beds, while a series of greyish grits, resting upon black shales, at the Stand Quarry, Knowsley Park, are the lowest beds—the deepest strata visible within the same distance of Liverpool.

A bed of Coal, 2 feet thick, has been worked in this series in Knowsley Park, at Hag Delph; but as this was many years ago, little is now known about it. There are at present no openings in the strata, otherwise, marine shells, so common in other

localities, would, no doubt be obtainable; Goniatites, Aviculopecten, Spirifer, &c., being characteristic of these strata, as at Pimbo lane, near Wigan.

Sections of the strata, at Huyton Quarry, Thatto Heath, Neston, and other places, show the position of the New Red Sandstone in respect of the underlying Coal formation. In each section, the Trias is thrown down against the edges of the Coal-measures, leading to the conclusion that the Coal strata are continued beneath the New Red Sandstone. From these and many other interesting sections in the neighbourhood, the following conclusions have been drawn:—

1st. That faults usually separate the New Red Sandstone from the Coal-measures in the district around Liverpool; the exceptions being overlaps.

2nd. That the Coal-measures were denuded *principally* after the deposition of the Trias.

3rd. That the middle productive Coal-measures underlie the New Red Sandstone between the River Dee and Huyton; and that coal would, probably, be reached at moderate depths, on both sides of the Mersey, at the up-cast side of faults.

In addition to the favourable spots shown in a section published in 1856,* Eastham and the Dingle are places where collieries will be worked at no very distant period.

The importance of adding to our carboniferous deposits is very obvious. The consumption of Coal in Great Britain amounts to 67,000,000 tons per annum; but even this large quantity will probably be insufficient for the increasing supply of future years. Coal-mining is not usually carried on so low down as 2,000 feet. If mining was limited to that depth, some of us might live to see an advance in the price of Coal. A work just published by Mr. Hull, "On the Coalfields of Great Britain," gives a great deal of useful information on a subject

* Proceedings of the Literary and Philosophical Society—Session, 1855-56.

upon which he is, perhaps, better able to give an opinion than any other person in this country. He gives a very favourable opinion upon the possibility of obtaining Coal to the depth of 4,000 feet, and then endeavours to show, at the present rate of consumption, based on calculations of quantity to 4,000 feet below the surface, *that there is enough of coal to last for* 1,000 *years*. In addition to the vast increase of supply to be obtained from deep mining, Coal will, before long, be obtained by boring through the Triassic and Permian rocks in situations many miles from the out-crops of any carboniferous strata. In the midland counties shafts penetrate through the lias and red marl to productive beds of Coal. About Manchester the Permian is passed through in several shafts. These places are, however, all upon the borders of Coalfields, the borings passing through overlaps of the superincumbent strata.

A paper was also read—

ON THE RECENT CEPHALOPODA.

By THOMAS J. MOORE, Corr. Mem. Z. S.

(Curator of the Public Museum.)

The object of this paper was to bring before the notice of the Society in a connected form the materials accumulated for the illustration of this division of the Mollusca in the Typical or Educational Collection of the Free Public Museum. The characters of all the genera were briefly enumerated, and examples of the following exhibited:—Octopus, Eledone, Argonauta, Sepiola, Rossia, Sepia, Spirula, Loligo, Sepioteuthis, Onychoteuthis, Ommastrephes, and Nautilus. Among the more interesting specimens were the following:—A large Octopus vulgaris, taken in the Albert Dock, Liverpool,

in 1854. This specimen lived twenty-four hours in confinement, and whenever the strong light of a moderator lamp was thrown upon it during the night, that portion of the animal exposed to the light was immediately suffused with a deep tint of Sepia.*

Second. A specimen of Rossia (macrosoma?), captured at New Brighton in 1857. This genus, of rare occurrence in any part of the British coast, had not previously been detected in the estuary of the Mersey.

Third. The "pen" of a gigantic Squid. The animal from which this was taken was captured by Captain Mortimer, of the American ship "Florida," about 200 miles N. W. of Bermuda. It was nearly nine feet in length—was estimated to weigh 8½ cwt., and required six men to hoist it into the vessel.

From the fact of this Squid having been provided with hooks on the arms, as distinctly stated by Captain Mortimer, it, in all probability, belonged to the genus Onychotenthis. The pen itself measures 3 feet 9 inches. The 'beak' of the same creature is in the collection of Mr. Francis Archer.

It was remarked by Dr. Collingwood that the Cephalopoda are extremely well-illustrated upon our own shores; all the British genera, excepting only Ommastrephes, being found on the Liverpool coast.

* The above specimen is the one referred to in Proceedings, 1859-60, p. 32.

THIRTEENTH ORDINARY MEETING.

ROYAL INSTITUTION, 15th April, 1861.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

Mr. JAMES BLAKE was elected a member.

Among other donations laid upon the table, the PRESIDENT called particular attention to a set of the volumes of Proceedings of the Royal Society, from A.D. 1800 to the present time, and announced that this valuable acquisition was due to the activity of the Honorary Secretary, who was doing much to improve the society's library.

A communication from the Council was made to the society, to the effect that it was recommended that the members should dine together, at some suitable time and place, during the recess. Childwall, and the latter part of May, were mentioned, and the proposal met with the cordial approval of those present. A committee was appointed to make the necessary arrangements.*

Dr. COLLINGWOOD exhibited a cuttle of the genus Rossia, taken by Mr. A. Higginson, at New Brighton, some years ago. It was but recently that this rare animal was known as an inhabitant of our shores, and now two specimens have been brought forward, both from New Brighton, and probably of different species.

The following paper was then read—

* This dinner took place at Childwall Abbey Hotel, on Monday, 13th May. The beauty of the day enhanced the success of the gathering, which was of the most agreeable nature. Covers were laid for forty-five gentlemen, being as many as the room would comfortably accommodate; and the guests, having first

CONTRIBUTIONS TO BRITISH ORNITHOLOGY;— THE NOTES OF BIRDS.

By CUTHBERT COLLINGWOOD, M.A., F.L.S., &c.

The subject of the present paper, if it possess no other merit, is, at least, appropriate to the season, since our woods already resound with the songs of our indigenous birds, while the first instalment of the more musical band of foreign visitors has already appeared among us.

I hardly think, however, that the subject needs any defence, inasmuch as it is one of considerable interest to the general naturalist, and, to the ornithologist, *essential*. It is, moreover, a subject which, in my opinion, is singularly neglected. True, that in most ornithological works, a few pages are devoted to the notes of birds; but, as far as my experience goes, the cursory remarks found in these works are of a very general nature, and, in most cases, mere repetitions, copied from one author into another. In scarcely any work that I am acquainted with, is the subject fully entered into as a matter of personal

assembled on the bowling-green, sat down to dinner at four o'clock. The chair was taken by the Rev. H. H. Higgins, M.A., President, who was supported on his right by the Worshipful the Mayor (S. R. Graves, Esq.), and, on his left, by Mr. J. A. Picton, F.S.A., Vice-President. The vice-chair was occupied by Dr. Edwards, senior Vice-President; and among the company were Dr. Ihne, Vice-President, Mr. Byerley, Treasurer, Dr. Collingwood, Hon. Sec., Drs. Nevins and Walker, Revds. Dr. Hume, Macnaught, Hindley, and Robberds, Messrs. Clark, Rediah, &c. A very creditable repast was served, and the cloth having been removed, and the usual loyal toasts disposed of, the President proposed, "The town and trade of Liverpool," with the health of his Worship the Mayor, to which that gentleman responded in the graceful manner which is natural to him. His Worship then proposed, "Success to the Literary and Philosophical Society," to which the President responded. "The kindred Societies," were the subject of a toast proposed by the Vice-chair, and responded to by Mr. Clark. Dr. Ihne proposed, "The Free Public Library and Museum," with the health of Mr. Picton, who responded. The "Friends and Visitors" were proposed by Mr. Rediah, and acknowledged by Mr. Cummins. "The Honorary Secretary," proposed by the Vice-chair, and responded to with musical honours, was acknowledged by Dr. Collingwood; and after the toast of "The Ladies," the party broke up—all highly pleased with the success of the entertainment, which partook rather of a humorous and amusing, than of a formal and unbending, character.

knowledge, and when descriptions *are* given of the notes of particular birds, they are most frequently of so diffuse and general a character as to have but little practical value.* Doubtless, there are many who have a profound acquaintance with the voices of birds, even approaching that of the Grand Vizier, in the *Spectator*, who, indeed, is not so fabulous a personage as at first sight he would appear to be; but these persons do not give the benefit of their experience for the guidance of others, and the subject is so purely one of experience, that it is only those who *can* give useful information upon it.

The language of birds is, then, only to be learned in the woods and fields—only to be taught by Nature herself; at the same time, however, the hints of experience should not be neglected, for although it is useless to remain *satisfied* with these, and suppose *them* sufficient in themselves for a knowledge of the subject, still they may greatly assist the student of ornithology in his endeavours to identify the various birds by their multifarious notes; and let no one think that such a study is altogether useless. I have before said, that for the ornithologist, properly so called—not the ornithologist who is content with books and plates, however elegant, but for him who goes out into the native haunts of birds, and enquires for knowledge at the fountain-head—for such an one, a knowledge of bird-language is indispensable, and of constant application. It is a *specific* character which thrusts itself upon the attention, and appeals to the ear resistlessly. By means of it, in our own country, the arrival of foreign visitants and of migratory birds is readily noted, and a clue is obtained to

* There is much interesting information in Barrington's well-known article (Phil. Trans., 1773); also in Bolton's "Harmonia ruralis;" Gardiner's "Music of Nature," &c., but these are of old date, and Kircher's quaint remarks in "Musurgia" are more curious than practical. There are many interesting notices scattered through Loudon's Magazine of Natural History; and the general reader will find much information in the "Domestic Habits of Birds" (Library of Entertaining Knowledge); and also in an article on the songs of birds by the late P. B. Duncan, in the "Literary Conglomerate."

the habits and existing conditions of indigenous birds; while in foreign countries, a careful attention to the voices of birds not only would greatly facilitate the discovery of new species, but the detection of European birds, or, indeed, the negative knowledge—the absolute certainty that such a bird is not the European species—would assist greatly in elucidating the phenomena of migration.

I have called it language, for such indeed it is, which, like its analogue, human speech, has undergone a Babel-like confusion; nevertheless, each species comprehends the notes uttered by its own, but these notes do not influence another species. Indeed, the analogy may be carried even further. The human voice utters certain sounds which, by a national freemasonry, are understood by all alike, however different their tongue—so with birds, there are certain sounds which are understood by all birds in common—the sounds, that is, which indicate the near approach of common danger. Besides all this, it must ever be borne in mind that birds are, next to man, most gifted with the power of expressing by sounds the feelings and impulses which arise under the various conditions and circumstances in which they are successively placed. Although, however, I purpose, in the present paper, to address myself more particularly to the warble, or love-song, of birds, it must not be imagined that they have no other vocal gifts. The male, the female, and the young, all have their peculiar notes, a knowledge of which may be of service, as it cannot fail to be of interest, to the ornithologist. The male has his defiant note, or battle-cry—his loud outcry when danger approaches—the call he possesses in common with the female, by means of which they are constantly informed of each other's whereabouts—the soft note which he employs when feeding the sitting hen, as well as the more or less brilliant serenade with which he, perhaps, banishes her *ennui;* the female has her complacent chuckle, when surrounded by her

little brood—the notes of invitation when food is forthcoming —of alarm on the approach of danger; while the young have their infantine squeal,—their strengthening notes before being fully fledged,—and their gradually perfecting recording notes thereafter. All these are distinct from one another, as well as different in each species of bird. All these notes, therefore, if known, give certain indications to the listener—all assist in the investigation of habits; and a person armed with such knowledge is in a position to study their habits immensely superior to that of one who is ignorant of them. The value of such knowledge may be better inferred from the fact mentioned by a writer in the Quarterly Review (vol. xviii., 1817), who states, on personal authority, that one individual, who had passed much of his time, in boyhood, alone, in lonely situations, had, by close attention, acquired such a knowledge of this language, that from the song of the parents, he knew where the nests were situated, whether they contained eggs, or whether the brood was hatched, knowing even the number of young birds, and their eggs before he saw them. Incredible as this may appear, we can readily imagine its possibility.

I need not dwell longer upon the uses of this kind of knowledge which I have sufficiently indicated. As for its *pleasures*, no one but those who have tried them can by any means appreciate them; not only that the voices of birds give a general delight which the educated and uneducated can alike appreciate, but I will venture to say, without fear of contradiction, that a knowledge of the meaning of each note as it strikes upon the ear—the power of identifying each song with the particular species that utters it, affords a delight and recreation—keeps the mind constantly employed—and relieves the tedium of many an otherwise dreary, solitary walk, substituting for *ennui* and weariness, a pleasure only known to the true ornithologist.

But the subject is so extensive, that I shall in vain endeavour

to compress its principal salient points into the compass of a single paper; and must pass over some of them rather hastily.

For this reason, I shall not dwell long upon the anatomy of the organs of voice, which may be found described in many places. The trachea and its appendages are the organs which produce these various sounds; but the trachea differs from that of man by possessing a double larynx, and two rimæ glottidis, the upper of which is at the upper end of the trachea, and is not furnished with an epiglottis. The lower or bronchial larynx is situated at the bifurcation of the trachea, and contains also a *rima glottidis*, formed by tense membranes, which may be compared in many cases (particularly among aquatic birds) to the *reed* at the mouth of musical instruments. These membranes, susceptible of various tensions and vibrations, constitute a true glottis, provided with everything necessary to produce sound. This is an abstract of the results arrived at by the dissections of Blumenbach, and by Cuvier, detailed in the *Journal de Physique* (I. 142); and his experiments prove that the voices of birds are produced in fact by this *lower* glottis at the base of the trachea; while the upper glottis contracts and widens for the modification of the sounds, and the muscles, along the trachea, from time to time, vary the length of that instrument, producing the same effect as long or short organ pipes. The trachea thus becomes an instrument to conduct *sound*, instead of a mere tube to conduct *air* from and to the lungs. Cuvier further adds that he found this organ absent in *one bird only* of those he dissected, viz., the King of the Vultures (Vultur papa). The organs of voice of birds, therefore, most resemble French horns in their general structure.

Some doubt appears to rest upon the real object of the long circumvoluted trachea in certain Natatores, but I imagine that this singularly developed organ has other uses than for singing

or screaming. In singing birds, generally, it is short, and lengthens with age. But I think old Kircher was probably right in connecting these circuitous tracheæ and their osseous chambers or ampullæ, so common in the Anatidæ, with their aquatic habits, supposing them to be reservoirs of air for the use of the bird when feeding under water.

The question now comes—since every bird, as I have already said, possesses some kind of voice, and more or less notes, but all kinds do not sing—What, then, is *singing*, and how defined? The most original writer upon the singing of birds is certainly the Hon. Daines Barrington, the well-known correspondent of Gilbert White, an accomplished naturalist, to whom I shall have again to refer. His experiments, which are the groundwork of all the subsequent remarks on this subject, are detailed in a paper *On the singing of birds,* read before the Royal Society, and published in the sixty-third vol. of Phil. Trans. There are many curious observations in this paper well worthy attention, though there is much besides which must be referred to the eccentricity of its author. In this paper, he defines song to be, "A succession of three or more different notes, which are continued without interruption, during the same interval with a musical bar of four crochets in an adagio movement, or whilst a pendulum swings four seconds." With the former part of this definition, I perfectly agree. I certainly do not consider a bird in the light of a *song-bird* unless he has at least three distinct notes. Less than these would be a mere *call;* and even three notes sometimes appear to be uttered by some birds which have no claim to the title of singing-birds; but such birds constantly *repeat* their limited notes with an execution anything but musical, as, for instance, the domestic cock; while the tits, for example, have but two or three notes, which, however, they vary infinitely, and give with great sprightliness and effect. But I think Barrington errs in favour of a prejudice which I shall speak

of later, when he says that a true song must last at least four seconds; for that would exclude such birds as the hedge-sparrow and chaffinch, whose songs I have frequently timed, and found them barely to extend through the stated period, although a great number of notes are uttered, and those, too, given with considerable execution. I am not aware of Barrington's reason for assigning four seconds as the smallest limit; but I fancy it is because of his musical ideas of the notes of birds, as though they should sing in *common time*. But I know no other reason, beyond an arbitrary one, why three seconds should not be the limit, or even less. For a bird will crowd a great many notes into a very brief space, as my own observation has shewn me. Thus, I have counted twenty notes in the song of a hedge-sparrow which did not exceed two seconds in duration, though the ordinary length of its song is nearer four seconds. But the gold-crest and creeper, which generally utter twelve to fifteen notes, scarcely ever come up to the limit of three seconds.

All birds have some *language*, emphatically speaking, by means of which they may communicate with one another of the same species; and there are even some notes which every species appears to understand in common—an universal language, comprehensible by all. The amatory warble, or song, however, is confined to comparatively few; but of all the various notes of birds, *that*, perhaps, is the least like language; for, if a bird utters his song at all, it is performed with more or less of liveliness and cheerfulness; whatever may be the external circumstances, it appears to indicate happiness; but those birds which possess far inferior powers of voice can, nevertheless, modulate it, and give it character and meaning to a truly wonderful extent. The single *caw* of a rook can be varied infinitely, so as to express every possible emotion; and a person who listens for the first time, will be astonished at the variety which he will discover in the meaning of a single

note. This gift, which may thus be compared to *speech*, is universal among birds, whereas, song is the attribute of only a small portion of the feathered creation, and these are all included within the single order of Insessores, which, however, includes a vast assembly of birds. An exceptional instance certainly occurs in the case of a Raptorial bird, viz., the Falco musicus (Daudin) or Fauçon chanteur; but these Raptorial birds are in general by no means melodious. The eagles and falcons utter a shrill or wailing scream—the vultures are capable of nothing beyond a "gruff caw," and the owls give forth a melancholy hoot or shriek which may well scare a benighted traveller.

The Scansorial birds, in general, utter the most hideous shrieks, and the shrillest and most discordant noises, though, at the same time, among these are found those birds which, owing to their docility, and peculiar structure of tongue, &c., are most capable of uttering articulate sounds. The Gallinaceous birds have generally the most powerful voice, though unmelodious and unmusical in the extreme, as the peacock and Guinea fowl. The Waders can do nought but scream discordantly, though in this accomplishment they are certainly outdone by the Natatory, or swimming birds.

But, with the single exception before referred to, all singing-birds, properly so-called, are to be found in the ranks of the Insessorial, or perching birds; and among *these*, but a very small minority are so gifted. Indeed, with one or two exceptions, only five families out of twenty-five, into which the Insessores have been divided, are singing birds. These families are the following—Of the tribe Dentirostres, the Merulidæ (thrushes), Sylviadæ (warblers), and such Ampelidæ (chatterers) as compose the genera Vireo and Pachycephala. The other two families belong to the tribe Conirostres, and are the Fringillidæ (finches), and Sturnidæ (starlings). Striking exceptions occur in the case of the swallow, a Fissirostral, and

the wren, a Scansorial, with which last also the creeper (Certhia) claims to be associated.

Perhaps there is no question relating to birds which has been more frequently debated than the *reason* of their song. It has long been a generally received opinion, for which De Buffon is quoted as an authority, that the song of birds is wholly and solely intended as a solace to the female during the tedious period of incubation. This, it has been urged, is the only object of their melody, as the poet of Nature, generally truer to Nature than to prejudice, expresses it (Spring, 614)—

> " 'Tis *love* creates their melody, and all
> This waste of music is the voice of love."

Now, it is certain that the time when birds, in their natural state, are in most perfect song, is just that period when the business of pairing, and nidification, and incubation, is going on; but although birds sing strongest then, it must be clear that that is not the only time when their voices are heard. After the brood is hatched it is true that most birds cease singing, for they have more serious business to attend to, viz., the feeding of young ravenous creatures, which require a fresh supply every two or three minutes, or even oftener, during the entire day. As the parent bird usually can only carry sufficient for one young one at a time, and there are generally four or five of them, the male and female are equally busy in the search for grubs or seeds, and no time is left for the cock to sit upon a spray and warble his ditty. But in the autumn, when all nidification and incubation is concluded, the song reappears in many indigenous birds, and even in several visitors. Of those that remain, some have already winged their way south, doubtless to expend their music upon some boundless and uninhabited solitude. Again, if song is such a consolation and solace to the sitting hen, why is it confined to so small a minority of the feathered tribes? Why should so

many be deprived of that solace? These questions must be answered by the upholders of such a theory. Caged birds, when abundantly fed, and kept warm and clean, sing all the year round—except during the autumnal moult—become, in fact, perennial, instead of annual songsters; and Swainson says that "in more genial climates, and especially between the tropics, the forests resound all the year round with the notes of birds, both before and after incubation;" * and, indeed, we see a similar phenomenon occur even in this northern latitude; not only do many birds resume their songs in autumn, but some, for instance, the robin and the wren, sing the whole year, with the exception of the moulting season, even during frost and snow. Thus, in 1854, I missed the red-breast's voice only three weeks in the whole twelve months. I have heard him in frost and snow, again and again; and on one of the most arctic days we have experienced in this climate (occurring in January), I have heard the wren and the bunting singing merrily. Now, as nidification only takes place in spring and summer—this autumnal recommencement, and this winter display of song, shew pretty clearly that it is not dependent *only* on amorous feelings; nor is it intended *only* as an address to the female. What, then, is the object of song? It may be a complex one, and this question, perhaps, will best be answered by a relation of the conditions under which birds sing. These are truly numerous and diverse. Col. Montagu, indeed, asserts that whenever, and at whatever time of the year birds sing, their testes will be found enlarged; but to prove this satisfactorily, would, I imagine, require larger data than is likely to have fallen to the lot of that accurate observer.

One of the chief conditions under which birds sing, next

* I am informed, however, by Mr. Charles Waterton that, in the South American forests, there are periodical intervals of silence, corresponding with the rainy season.

to those we have just referred to, is *a spirit of rivalry*. Thus, Barrington, in his paper on the singing of birds, says that the bird-catchers lay considerable wagers whose call-bird will jerk the longest, as that determines the superiority. "They place them opposite to each other by an inch of candle, and the bird who jerks the oftenest before the candle is burnt out wins the wager. We have known a linnet, on such a trial, persevere in its emulation till it swooned from its perch." Mr. Sweet, in his "British Warblers," gives instances of birds falling dead from their perch when trying to outrival some other bird confined with it in the aviary.

Another condition under which birds sing is in the excitement of an unusual noise. Thus, a caged bird will sing when a noise is made, whether harmonious or discordant; and I have heard a nightingale sing continuously in a bush within half-a-dozen yards of the Great Western Railway, while a long and heavy goods train has been thundering past at dead of night.

Some birds sing immediately that they are disturbed. Instead of being frightened and silent, a sudden disturbance will set them singing. This is especially the case with the nightingale, and the sedge-warbler, both nocturnal birds; and many a time I have discovered the presence of the latter, when silent, by throwing a stone into the willow-patch where I supposed him to be concealed, and he has forthwith commenced his lively song.

No external circumstance of weather will prevent a bird from indulging in song. The most miserable degree of cold or wet, or both, only seems to animate him. Thus, I have frequently remarked in early morning, when the singing of the birds has induced me to expect bright weather, on looking forth, the utter wretchedness and cheerlessness of the scene has disappointed and surprised me. Indeed, some birds seem to rejoice in these sorts of miseries. The missel-thrush is well known under the name of *storm cock,* from his habit of

singing loudest when the wind and storm are highest; and I have remarked the wild warble of the blackbird to be exultant all through a sharp storm of thunder and lightning.

Again, birds have been known to sing under circumstances which, according to our pre-conceived notions would be discouraging in the extreme, and little incentive to any expression of love or joy. Birds which have been taken by the bird-catchers often sing the instant they are trapped. Barrington says a nightingale was brought to him which had only been a few hours in the cage, when it burst out into a roar of song; and even more striking instances have been related.

Amongst birds which have no song, properly so-called, some use their notes in a peculiar and characteristic manner. Thus, pheasants always crow when they go to roost, as though to give a premium for poaching. Swifts are very clamourous just before they retire for the night; and the same thing must have been observed by every one in relation to sparrows and rooks. The loud cries, too, of birds, especially aquatic birds, which travel overland during the darkness of the night, are evidently uttered for the purpose of keeping together the members of the travelling party; while, in like manner, birds which have paired, or which have a brood capable of joining them in their flight from bush to bush, constantly utter a complacent chirp, which serves as a notice of their proximity, and keeps the whole party together.

A very interesting question in connexion with the singing of birds is, whether their song is innate or acquired. A great deal has been written upon this subject, and the Hon. Daines Barrington made several patient experiments in order to satisfy himself upon it; the result of his observations being to convince himself that "notes in birds are no more innate than language is in man;" but, without entering into a critical examination of all his data, I must confess that I see cogent

natural. But the constancy of all birds in a state of nature to the pipe of their own species—a constancy which no observed fact has ever been brought forward to shake—is, to my mind, irrefragible proof that those notes are, if not absolutely innate, at all events so strongly impressed on the bird's nature, that, under ordinary and normal conditions, it would attempt no others. All the instances of birds singing other notes than those of their own species are related of *caged* birds, and Barrington admits that, under these circumstances, it is "very uncertain what notes the nestlings will most attend to, and *often their song is a mixture.*" In a natural state, on the contrary, it is very *certain* what notes a bird will sing; as Barrington expresses it in the next paragraph, "in a wild state, they adhere steadily to the same song, insomuch that it is well known, before the bird is heard, what notes you are to expect from him." *

Having thus touched upon the questions, how, when, and what birds sing, I will now dismiss these general considerations, and in what follows, shall devote more particular attention to our British birds of song. It is generally admitted by those who have paid attention to ornithology, and who have heard the vocal exhibition of foreign countries, that we have, in our own island, a chorus of song-birds second to none. The plumage of our songsters is in general nothing to boast of, but the sweetness and variety of their tones carry off the palm. Indeed, song and plumage, as a general rule, are inversely proportioned to one another, and the gayest birds have often the vilest voices. According to the restricted definition of song given above, we may reckon as many as thirty-six singing birds, of which twenty-three are indigenous,

* Barrington also admits elsewhere, "that the bird called a *Twite* by the bird-catchers commonly flies with the Linnets, yet those two species of birds never learn each other's notes, which always continue totally different."

and thirteen, summer visitors.* The notes of these are each characteristic, and although space will not allow me to describe them individually, I shall, by arranging them in a tabular form, endeavour to convey some idea of their affinities and mutual relations.

Barrington has given in a note, a table which professed to shew the comparative merit of our song birds; the idea of which, he tells us, he borrowed from Mons. de Piles, in his "Cours de Peinture." This table, although well-known, I shall, for the sake of illustration and comparison, introduce in this place:—

DAINES BARRINGTON'S TABLE OF THE COMPARATIVE MERIT OF BRITISH SINGING BIRDS.

20, the Point of Absolute Perfection.	Mellowness of Tone.	Sprightly Notes.	Plaintive Notes.	Compass.	Execution.
Nightingale	19	14	19	19	19
Skylark	4	19	4	18	18
Woodlark	18	4	17	12	8
Titlark	12	12	12	12	12
Linnet	12	16	12	16	18
Goldfinch	4	19	4	12	12
Chaffinch	4	12	4	8	8
Greenfinch	4	4	4	4	6
Hedgesparrow	6	0	6	4	4
Aberdavine (or Siskin)	2	4	0	4	4
Redpoll	0	4	0	4	4
Thrush	4	4	4	4	4
Blackbird	4	4	0	2	2
Robin	6	16	12	12	12
Wren	0	12	0	4	4
Reedsparrow	0	4	0	2	2
Black-cap, or the Norfolk Mock Nightingale	14	12	12	14	14

* There are, in addition to these, nine or ten other birds which enjoy the reputation of singing birds, but as these only visit us in the *winter*, they are not often heard in this country. Such are the Siskin, Redpoll, Brambling, Grey Wagtail, &c. If to these be added the Tits (Parus,) which some may consider as worthy of admission into the list, we have then about 50 songsters in our Avifauna.

There are few, I fancy, who will be disposed to agree in this estimate of the powers of our feathered favourites, and although the table is frequently cited, it is always done under protest, and rather as a curiosity than for any intrinsic merit. For my own part, I have often wondered that so acute an observer, and ardent an admirer of our song-birds as the Hon. Daines Barrington undoubtedly was—one, too, who was evidently possessed of a musical ear—should have so far erred in his estimate; and it is not easy to discover the principle which he employed in the construction of the foregoing table. He says, indeed, "I shall not be surprised, however, if many may disagree with me about particular birds," but, still, I cannot believe that the subject is so much a matter of caprice as this would indicate, or as the table would appear to prove. I think it may be partly owing to the fact that Barrington was accustomed to judge of birds, not in their wild state, but as "cribbed, and cabined, and confined," having received more or less *instruction*, and more or less of what he would have called *opportunities of improvement*. In these respects, he was an artificial ornithologist, one who delighted not in what he called "the *rank* song of a nightingale in spring," but made all his observations upon caged birds, which had been duly educated by art, and sung, in spite of nature, all the year round. If we compare, in his table, the voices of the Thrush and Robin, or those of the Blackbird and Greenfinch, it will be at once apparent that it is largely defective, and except in its form, solely a curiosity.

Mr. Barrington does not appear to have attributed perfection to any bird, even though nature and art should combine to attain it; in which I think he errs. He has given 20 as the point of perfection, but no bird is so gifted as to reach it, not even his favourite Nightingale, which "sings with superior judgment and taste," and again, with "a most astonishing effect, which eludes all verbal description," &c. Surely, in the works of Nature, perfection is somewhere reached, and the

Teacher of our woodland vocalists would never pause at 19 in his masterpiece, when 20 was attainable. Further, Mr. Barrington seems to have had a partiality for particular numbers, and an analysis of his table shews, that out of 76 numerals employed, the number 4 occurs 29 times, and the number 12 seventeen times; these two numbers thus comprising together 46 out of 76, of which the table is composed.

I have often been surprised that this table, formed by Barrington in 1773, although it has attracted much attention, has never been imitated with a view to improvement and perfection. Such an improved table would naturally be a source of much amusement in its formation, as well as of some interest to those well acquainted with the varied voices of British birds, in the comparison of its results with their own ideas and feelings. I venture therefore to offer the following, not as a perfected, but as a somewhat improved scheme upon that of Barrington's, founding its claim for improvement upon the following considerations:—

In the first place, the numbers are derived from a careful observation of the birds in their native haunts in spring, when their powers of song are in the most perfect natural condition. Secondly, I have introduced a considerably larger number of birds than those referred to by Barrington, in fact perhaps all those which have any claim, when judged by our definition to be regarded as British singing birds, and numbering 36. Thirdly, I have made 24 the point of perfection, instead of 20; because I thought that by so doing, the facilities for comparison among a so much greater number of birds would be proportionately increased, without incurring any loss in the general plan. Fourthly, I have admitted that the point of perfection is attained by at least some one bird in each of the qualities, considering the bird against which 24 is marked as the type of that quality. Fifthly, I have superadded to the five qualities mentioned by Barrington, a sixth, viz., power or strength of voice, as decided by the distance at

which it can be heard; in my humble opinion, a very essential element of a fair judgment in the consideration of tones as sonorous as those of the Missel-Thrush, and again as weak and feeble as those of the Goldcrest. And, lastly, the whole has been framed with a due regard to a strict comparison between birds most allied to each other in the nature and quality of their notes, by which any great discrepancy is necessarily avoided.

TABLE OF THE COMPARATIVE MERITS OF BRITISH SONG BIRDS.

(IMPROVED AND CORRECTED.)

No.	24, the Point of Perfection.	Mellowness of Tone.	Sprightliness.	Plaintiveness.	Compass.	Execution.	Strength of Voice.
1	Dipper	10	18	6	18	16	20
2	Missel Thrush	8	2	12	5	4	24
3	Song Thrush	17	14	8	16	14	20
4	Blackbird	24	6	14	16	10	18
5	Hedgesparrow	6	8	12	16	9	6
6	Redbreast	10	15	20	10	9	12
7	Redstart	8	12	10	12	12	8
8	Stonechat	6	10	7	9	9	7
9	Whinchat	8	12	8	10	12	10
10	Wheatear	6	14	6	10	10	10
11	Sedge Warbler	4	15	10	14	16	12
12	Reed Warbler	10	16	10	16	18	14
13	Nightingale	22	14	24	24	24	17
14	Blackcap	22	16	14	20	22	16
15	Garden Warbler	20	15	16	18	17	17
16	Whitethroat	6	16	10	15	16	12
17	Lesser Whitethroat	6	14	8	10	12	10
18	Willow Warbler	10	16	14	10	8	14
19	Goldcrest	0	11	6	8	6	4
20	Pied Wagtail	9	14	10	12	10	10
21	Tree pipit	6	12	14	16	14	16
22	Meadow-pipit	8	14	15	17	15	16
23	Skylark	6	20	4	18	18	23
24	Woodlark	20	16	20	12	18	15
25	Black-headed Bunting	4	8	4	6	6	10
26	Cirl Bunting	2	7	6	5	6	14
27	Chaffinch	14	16	12	13	17	15
28	Tree sparrow	0	4	2	5	5	12
29	Greenfinch	10	12	8	10	14	10
30	Goldfinch	11	14	10	14	17	16
31	Linnet	15	12	15	12	16	9
32	Bullfinch	7	5	6	8	8	7
33	Starling	8	12	14	16	12	6
34	Creeper	0	9	5	6	5	4
35	Wren	0	24	0	12	16	16
36	Swallow	12	18	16	16	17	10

An analysis of the foregoing table shews that the Blackbird has been selected as the type of the quality of mellowness of voice, the Wren for sprightliness, and the Nightingale for plaintiveness—the last, of course, carrying off the palm in compass and execution. For strength of voice the Merulidæ are all remarkable; the loudest, perhaps, being the Missel Thrush, though the Lark nearly approaches him in this particular.

In this table the birds are arranged according to their *families*, but the sum-total of the figures appended to each bird will give the following *scale of superiority* in song:—

	Bird.	Total.		Bird.	Total.
1	Nightingale	125	19	Sedge-warbler	71
2	Blackcap	112	20	Starling	68
3	Garden Warbler	103	21	Wren	68
4	Woodlark	101	22	Pied Wagtail	65
5	Skylark	89	23	Greenfinch	64
6	Song-thrush	89	24	Redstart	62
7	Swallow	89	25	Hedge-sparrow	61
8	Dipper	88	26	Lesser Whitethroat	60
9	Blackbird	88	27	Whinchat	60
10	Chaffinch	87	28	Wheatear	56
11	Reed-warbler	86	29	Missel Thrush	55
12	Meadow-pipit	85	30	Stonechat	48
13	Goldfinch	82	31	Bullfinch	41
14	Linnet	79	32	Cirl-bunting	40
15	Tree-pipit	78	33	Reed-bunting	38
16	Redbreast	76	34	Goldcrest	35
17	Whitethroat	75	35	Creeper	29
18	Willow-wren	72	36	Tree-sparrow	28

In order still further to exhibit the comparative powers of our British birds, and at the same time to arrange their numerous notes in something like an orderly series, the following system is offered, which shows the *type* to which each song-bird belongs, and locates each bird in an ascending series, according to such type, beginning with those whose notes are least numerous and varied, and gradually rising to the most powerful and accomplished vocalists.

First—Birds which possess but a single note or *call*.

The greater number of birds, by very far, as I have before observed, come under this category, and therefore, however much this call may be varied in *tone*, they are necessarily excluded from the rank of *singing* birds.

Secondly—The first approach to song occurs when this single note is repeated several times without an interval, constituting a *prolonged call,* as I will designate it, as in the case of

1 Wryneck,
2 Woodpecker,
3 Nuthatch,
4 Swift,
5 Wood-warbler
6 Grasshopper Lark, &c.

Thirdly—The next advance is when, instead of a single note, the bird is capable of producing two notes, which Barrington designates the *varied call.* Such birds are the

1 Cuckoo,
2 Chiff-chaff,
3 Common Bunting, &c.

According to that part of Barrington's definition, which I am willing to accept, we now arrive at true singing birds, having three or more notes. These may be arranged as follows:—

Fourthly—Birds which sing short passages, which they repeat frequently, but from time to time vary,

A. with an interval between each repetition, as

1 Missel Thrush,
2 Golden Oriole,
3 Blackbird.

B. without such interval,

1 Blue Tit,
2 Great Tit,
3 Song-thrush.

Fifthly—Birds which have a *definite number of notes.* This includes all the poorer song-birds, which have but few notes, as well as some of the better class. These birds sing their song round, and then repeat it, singing nearly the same notes each time; so that when the observer has once mastered the passage, he cannot well be deceived in the bird; such are

1 Tree-sparrow,
2 Creeper,
3 Reed-bunting,
4 Cirl-bunting,
5 Gold-crest
6 Stonechat,
7 Wheatear,
8 Whinchat,
9 Hedge-sparrow,
10 Redstart,
11 Greenfinch,
12 Wren,
13 Willow-wren,
14 Tree-pipit,
15 Meadow-pipit,
16 Chaffinch.

And *Sixthly* and lastly, are those birds which possess an *indefinite number* of notes, so that no two passages are precisely alike, and the observer judges more by the *quality of the tone* than by the *identity of the passages*. This class includes the greater number of our true singing birds, and may conveniently be divided into two groups, viz:—

A. Those whose song is uttered in what the bird-catchers call *jerks*, that is, passages more or less brief, but always varied, and separated by an interval; such as—

1 Redbreast,	3 Lesser Whitethroat,
2 Whitethroat,	4 Blackcap,

5 Nightingale.

B. Those whose song is *long sustained*, without any rest or interval, as—

1 Pied Wagtail,	6 Reed Warbler,
2 Starling,	7 Linnet,
3 Goldfinch,	8 Garden Warbler,
4 Swallow,	9 Wood-lark,
5 Sedge Warbler,	10 Sky-lark.

Our indigenous birds appear, some of them at least, to be capable of singing nearly the whole year, excepting only during the moulting season, and this is certainly an argument against the sexual cause of song. The Robin, the Wren, the Starling, &c., may be heard through the frost and snow of January, although it is quite true that they improve greatly in their qualities of voice during the breeding season. Other birds gradually take up their song as the spring advances. The Missel and Song Thrush also usually sing in January. In the course of February, the Chaffinch, Hedgesparrow, Lark, Greenfinch, Goldcrest, &c., gradually chime in. The Blackbird is rarely heard till March, when he is accompanied by the Linnet and Goldfinch.

The month of April, however, brings with it a great accession of song, on account of the arrival of the exotic songsters which make our spring woods so vocal. These

arriving, one after another, from the first week in April till the first week in May, very rapidly swell the chorus. Both indigenous and exotic songsters are, indeed, early in May, in full song—a marked improvement in tone and execution being observable even among those we have been accustomed to hear already for several months past. Thus, the Redbreast's note becomes full and sonorous, often rivalling the wild note of the Blackcap in some of its passages. The warble of the Chaffinch becomes more liquid, and an accession of power is generally noticeable. After the beginning of June, however, this climax begins to show symptoms of a decline: one by one, birds' voices are missed, or the rich tones deteriorate, and this process going on through June and July, it at length becomes the *exception* to hear a bird's song, instead of the rule; till at length, in August, a dead silence reigns in the woods and fields, and the birds are then as dumb as they are musical in May.

Whether this gradually increasing vocal power be due to a corresponding increase of pliability in the larynx, induced by practice, or to some correlative periodical change in the constitution of the bird, I cannot now enquire. Probably both causes are concerned, for we must take the analogous phenomenon of the decrease and disuse of song into consideration in any such enquiry.

Another question, too, presents itself, viz., what is the condition of migrating birds as to song, when they arrive among us? I think there can be little doubt that their vocal organs have previously reached their full pitch of power at that time, for several reasons.

First. They remain with us, in song, for so short a period (about six weeks) that time is scarcely allowed for any very great change; nor do we notice any in fact, the summer birds of passage being in good voice from the time they arrive till the time when their song begins to deteriorate.

Second. A careful observer will almost as soon learn by the *ear* as by the eye the arrival of summer birds, which announce their advent by their characteristic notes. I say *almost*, because it has several times occurred to me to see the bird only on one day, and to hear him on the next, and this under such circumstances as to leave no doubt that the fatigue of their journey only prevented them singing. On one occasion, in Kent, early in April, watching for the Willow-wren, not the slightest trace of which I had yet seen or heard, I espied one, which, while under my observation, uttered a mangled note, more like a recording note in autumn, and which I should scarcely have recognized. This was the only indication I had of the bird's arrival; but *next day* every tree-top resounded with the incessant warble of the species. A similar remark I have made with regard to the Redstart.

Thirdly, judging from analogy, we arrive at the same conclusion, for our winter birds of passage, which quit us in the spring, sometimes favour us with an audience before leaving.

After the period of silence, which marks the month of August, we often hear many species resume their song, but in a manner very far inferior to that of the spring months. The notes strike upon the ear like those of long absent friends, and as it always occurs to me, like those of friends just risen from a bed of sickness. Instead of the round, full, careless song of spring, we hear weak, vacillating and imperfect notes, which tell either of a loss of power, or of a newly commencing accomplishment. I certainly incline to the opinion expressed by White, and corroborated by the Rev. L. Jenyns, that these autumnal songsters are young cocks of the year. Without stopping to ask why the old birds should attempt to do that which they have not power to execute, it is to be borne in mind that this recommencement takes place at a time when we should look for the first indications of song in the young birds; at a time, that is, when they are fully fledged, and

perfectly able to shift for themselves. But if it should prove that the weak notes heard in autumn, are produced by young cocks of the year, it will be a strong argument in favour of the *innate* character of song, and its specific nature. For the old birds have confessedly ceased for some weeks or months, and therefore it cannot be contended that the young are being instructed by them. Moreover, in any case the spring song ceases, as a rule, before the young are in a position to profit by it as an example, unless, indeed, it be hardily imagined that they bear in their remembrance the notes they heard many weeks before.

As there is an *annual* or seasonal cycle in the powers of singing-birds, so also there is a *diurnal* one. The daily cycle has, however, this peculiarity, that it reverses the annual one in its character—the earliest beginning of the day presenting a climax, which subsides before mid-day. It is not a little interesting to watch, in a spot thickly populated by birds, for the moment of their awakening. Long before sunrise, even in the longest days, and when only an uncertain glimmer of twilight exists, scarcely sufficient to read the time by a watch, a sudden awakening takes place. A single bird, more wakeful than his fellows, commences singing; but he does not long sing alone. Birds of the same species, as though awakened by the familiar sounds, almost instantly reply. By degrees, other species commence in the same manner; at first one individual, rapidly followed by others of the same species. A solitary thrush, for example, breaks the silence, and before five minutes have elapsed, a dozen thrushes may be heard singing in all directions, springing into life all around, as if by magic. The effect is most startling and curious.

The following extract from a carefully observed occurrence of the kind will illustrate this circumstance (May 18th) :—

Hrs.	Min.	
3	5 (a.m.)	A Blackbird singing.
3	6 „	A Robin singing.
3	6¼ „	Two or three Blackbirds and Robins singing.
3	7 „	A Thrush singing.
3	7½ „	A Ringdove cooing.
3	11 „	Ringdoves cooing; Blackbirds, Thrushes, and Robins singing *everywhere*.

No other time of the day can compare with this for the loudness and richness of the song of birds; and no one can have an idea of what a chorus of song-birds means, who has not heard it between three and four o'clock of a May morning.

There is a remarkable constancy, almost to a minute, in the awakening of birds at the same place and season; and in two observations made within three days at the same spot, the difference of time in the awakening of several of the commoner species was not more than a minute or two.

Much difference of opinion has existed as to what bird commences this morning chorus. Several writers who have touched upon this subject, have done so evidently without any special observation upon it with a view to determine the truth. In the "Journal of a Naturalist," the author gives the Rook the credit of being the first awake, and says the Robin is next. Jenner, in the Phil. Trans. (1824, p. 37), "On the Migration of Birds," says—"First the Robin, and not the Lark, as has generally been imagined, as soon as daylight has drawn the impenetrable line between night and day, begins his lonely song." Messrs. Sheppard and Whitear, in their paper "On the Birds of Norfolk" (Linnean Trans., vol. xv., p. 18), say, that the Redstart is the earliest bird, but without observation to back the assertion. For my own part, I distinctly dissent from all these, and in company with the poet, generally so true, and with the Rev. L. Jenyns, I believe that the Lark is, after all, the first to awaken and lead the choir. Thomson truly says—

> "Up springs the Lark,
> Shrill-voiced, and loud, the messenger of Morn."

And Jenyns, in his "Observations in Natural History" (pp. 95, et seq.), gives detailed results of his morning remarks upon that subject, which precisely correspond with similar observations which I have myself made with care. On all these occasions the Skylark has been fully half an hour carolling in the air before any other bird shewed symptoms of awakening. The Robin usually follows the Thrush, and the Cuckoo is one of the very earliest birds.

As the morning advances, the birds cease their song, and in the heat of the day there is as little music as in August; but as the sun declines many birds recommence, and even continue singing after the sun has absolutely set, as the Thrush and Robin; and the Cuckoo, as it is one of the earliest, so also it is one of the latest birds to retire.

Some birds, however, do not find a May day long enough to exhaust their powers, but are as vocal at midnight as at mid-day,—of such birds, the Nightingale, Woodlark, and Sedge Warbler are well known—but besides these the following have been occasionally heard during the night, viz. the Hedgesparrow, the Skylark, the Reed Warbler, the Robin, the Whinchat, and the Cuckoo.

Lastly, there are many birds whose characteristic mode of delivering their song is on the wing—such are the Skylark, Woodlark, Tree Pipit, Meadow Pipit, Whitethroat, Swallow, and Wagtail. To these may be added the following, which do not, as a rule, sing as they fly, but occasionally do so, viz., the Blackbird, the Wren, the Titmice, the Greenfinch, the Chaffinch, the Dartford Warbler, the Goldcrest, the Willow Wren, the Blackcap, the Missel Thrush, the Dipper, the Wheatear, and the Linnet.

There are many other points of great interest in connexion with this subject, to exhaust which would demand a volume. The musical aspect of the songs of birds is one of those which I should have liked to touch upon, but it is too extensive;

the curiosities and abnormalities of song—the docility and flexibility of the vocal organ of birds—their powers of uttering articulate sounds, &c. It is possible that I may resume the subject, however, on a future occasion.

FOURTEENTH ORDINARY MEETING.

ROYAL INSTITUTION, 29th April, 1861.

The REV. H. H. HIGGINS, M.A., PRESIDENT, in the Chair.

Mr. ALEXANDER ECCLES, B.A., was elected a member.

Some discussion arose upon Dr. COLLINGWOOD's paper, read at the last meeting.

Mr. MOORE, of the Free Public Museum, exhibited specimens of two collections of fishes, lately sent to the Museum—the one from Madeira, where they were collected by Mr. J. P. G. Smith and Mr. Yate Johnson, and forwarded to the Museum by the former gentleman; and the second collection had been recently received, through Dr. Collingwood, from Professor Agassiz, the eminent physiologist, of Cambridge, U.S., and was the first instalment of what might be looked forward to as a valuable and extensive addition to our Public Museum.

Dr. COLLINGWOOD laid upon the table the British Association dredging list, which, in conjunction with Mr. Byerley, he had filled up for the district of Liverpool. He stated that, having been requested by the British Association to furnish a report of the dredging in the Mersey and Dee, he wished to make known to naturalists generally that he would be very glad of information on, or specimens of, the following

desiderata, viz., Tunicated Mollusca; the minuter Crustacea; the marine Entomostraca, infesting fishes; the marine worms of all classes; the Entozoa, or internal parasites of fishes; the genus Lepralia; the naked-eyed Medusæ; Foraminifera, and Sponges.

The following paper was then read:—

ON THE PHILOSOPHY OF SIR WILLIAM HAMILTON.

By CHARLES CLARK, Esq.

In venturing to lay before you a paper on the Philosophy of Sir William Hamilton, I am aware that I lay myself open to the charge of presumption. Adequately to appreciate his labours in the great field of metaphysical science, would require not only a far larger knowledge of its past history than any to which I can lay claim, but also a deep prophetic insight into that conflict of opinions of which indications from time to time are manifested, but whose final issue it may be reserved for another generation to witness. My only apology for dealing with this subject is, that when I was urged by your secretary to write a paper, my thoughts instinctively turned towards that science which possessed the greatest interest for my own mind; and I cherished the hope that, in a philosophical society like this, some account of the teaching of the greatest philosopher of modern times might not be altogether unacceptable. In addressing you on this topic, I am aware that I labour under another disadvantage. The majority of your members have devoted themselves to the study of the various physical sciences, and may thence, perhaps, have been led to undervalue the importance of the

science of mind. Certainly, if we dwell exclusively on the results hitherto attained, if we contrast the steady and gigantic progress which, since the time of Bacon, every branch of physical science has made, with the faltering steps and devious path of mental science during the same time, we may deplore, but we can scarcely be surprised, that such should be the case. On the one hand we see properties discovered, and laws of nature investigated, which not only add to the sum of our knowledge, but, in their artificial applications, and combinations, have multiplied immensely the powers and enjoyments of mankind. On the other hand, we find ourselves beset by contradictory theories, inexplicable phenomena, and insuperable difficulties; and we seem like the fallen angels of Milton:

"In wand'ring mazes lost,"

to reach at last as the result of our speculations,

"Not light, but rather darkness visible."

But if, turning from the consideration of mere tangible results, we take into our account the importance of the objects with which these sciences are respectively conversant—the material or physical world without, and the mental or psychical world within—we shall be forced to acknowledge that, worthy as is the boundless universe beyond of our admiration and study, the contemplation of our own mental being, of the powers and capacities which fix the boundaries and determine the conditions of thought, and through which alone knowledge is possible for us, is the highest and noblest that can engage our minds; and in this sense we may hold with Pope:

"The proper study of mankind is man."

And as an additional incentive to this study, it should ever be remembered that, apart from revelation, it is only through the philosophy of mind, by recognizing in ourselves moral,

intelligent, and spiritual agents, that we can rise to the conception of an intelligent Author and moral Governor of the universe, and establish our proof of the existence of a God. The poet just quoted speaks, indeed, of those who

"Rise from nature up to nature's God,"

but Sir William Hamilton has shown to demonstration that the only nature from which this inference can be legitimately drawn is the moral nature of man; for, whilst the universe of matter considered *by itself* presents us with an invariable succession of certain phenomena linked together by an inevitable law, revealing only a blind mechanical fate or necessity; the phenomena of man's moral nature, exhibited in consciousness, afford those attributes of freedom, intelligence, and goodness, which, carried to perfection and joined with Omnipotence and original causation, constitute our conception of the Deity. Kant, in a passage quoted by Sir Wm. Hamilton in his second lecture, has admirably discriminated the respective effects upon his mind of astronomical and moral science. He says:—"Two things there are which, the oftener and the more steadfastly we consider, fill the mind with an ever new, an ever-rising admiration and reverence—the starry heaven above, the moral law within. Of neither am I compelled to seek out the reality as veiled in darkness, or only to conjecture the possibility as beyond the hemisphere of my knowledge. Both I contemplate lying clear before me, and connect both immediately with my consciousness of existence. The one departs from the place I occupy in the outer world of sense; expands beyond the bounds of imagination this connexion of my body with worlds rising beyond worlds, and systems blending into systems; and protends it also into the illimitable times of their periodic movements, to its commencement and perpetuity. The other departs from my invisible self, from my personality; and represents me in a

world truly infinite indeed, but whose infinity can be tracked out only by the intellect, with which, also, my connexion, unlike the fortuitous relation I stand in to all worlds of sense, I am compelled to recognize as universal and necessary. In the former, the first view of a countless multitude of worlds annihilates my importance as an animal product, which, after a brief, and that incomprehensible, endowment with the powers of life, is compelled to refund its constituent matter to the planet—itself an atom in the universe—on which it grew. The other, on the contrary, elevates my worth as an intelligence even without limit; and this through my personality, in which the moral law reveals a faculty of life independent of my animal nature, nay, of the whole material world; at least if it be permitted to infer as much from the regulation of my being, which a conformity to that law exacts; proposing as it does my moral worth for the absolute end of my activity, conceding no compromise if its imperative to a necessitation of nature, and spurning in its infinity the conditions and boundaries of my present transitory life."

It would be an interesting subject of inquiry to trace the causes, and examine the history, of that revival of the study of pure philosophy which has taken place in this country during the last thirty years. That such a revival exists is evident from our current national literature. It underlies the theological controversies which are waged amongst us; it has contributed to sustain, or undermine, rival systems of education, of morals, and of politics; it has penetrated the realms of fiction; and has given a colouring and direction to the genius of our most gifted living poet, who defines his mission :—

> "As far as might be to carve out
> Free space for every human doubt,
> That the whole mind might orb about,
>
> To search through all I felt or saw,
> The springs of life, the depths of awe;
> And reach the law within the law."

But this branch of inquiry would lead me too far from the immediate subject of this paper, and encroach too much upon the limited time at my disposal to be further pursued now, and for the present I must reserve it; contenting myself with simply pointing your attention to the remarkable contrast which this interest presents, to the apathy, not to say the distaste, with which such studies were regarded not half a century ago. The next generation will scarcely believe that at a time within the memory of many now living, the study of the Philosophy of Mind was looked upon in England as little better than madness, and the name of a metaphysician had become a term of reproach. Nor was this prejudice confined to the ignorant and vulgar. If we may judge from the complaints of philosophical writers, and from the allusions to their science in the current literature of that day, we shall find this prejudice existing amongst many not otherwise deficient in learning and ability.

Is it not, then, worth our while to pause and ask for a moment, what were the causes of the disfavour with which metaphysical studies were so generally regarded, in a country distinguished among the nations of Europe for the number and acuteness of its metaphysical writers—the land of Scotus and Occam, of Locke and Clarke, of Hobbes and Butler, of Berkeley and Hume?—for unless we can believe such a revolution to have been merely accidental, the result of caprice and whim, we may expect to gain from an analysis of its causes valuable lessons for future guidance.

The first of these causes to which I would refer, is that confused and ambiguous use of terms which every philosopher has deplored, and few have avoided. This confusion and ambiguity, injurious in any science, is especially so in the science of Mind, where the phenomena to be observed and described are purely subjective, and in which, therefore, any ambiguity or uncertainty in the language employed to desig-

nate the phenomena, leads of necessity to erroneous results. This is so obvious that it might pass as a mere truism, but for the fact that some of those who, like Locke, have expatiated on the errors arising from this cause, have themselves, in their own writings, exhibited signal instances of its effects. Great as have been the services of Sir William Hamilton in other respects, there are few greater than those he has rendered in pointing out the errors of his predecessors which have sprung from an abusive employment of terms, and in introducing, and enforcing by his consistent practice, a more precise and accurate use of philosophical language.

Another cause, closely allied to, and partly springing out of, the one I have just named, was the conflict between the generally received theories with the common sense and natural beliefs of mankind. Developing the doctrine which the authority of Locke had supported, that the mind perceives nothing but its own ideas, and that "knowledge consists in nothing but the perception of the agreement or disagreement of these ideas," Berkeley maintained that there was no such thing in the universe as matter, that what appears to be such is merely an illusion of our senses, and that nothing exists but minds and spirits. Thus the theory of idealism was established on the ruins of the material world.

With equal cogency of argument, and equal disregard of common sense, the materialists reversed the argument; and since Locke had taught that all our ideas reach us primarily through the avenues of the senses, and must be either ideas of sensation, or of reflection founded upon sensations, they logically inferred that, as the phenomena of mind cannot be the objects of a sensation, such phenomena are in their nature illusive, and are in reality modifications of matter.

Emboldened by these contradictions, the sceptics entered the lists. Hume turned the weapons of the dogmatists against themselves, and proved with a merciless logic, which might be

abused, but could not be refuted, that, assuming the truth of their own principles, there was in the universe neither mind nor matter, subject nor object; nothing but shadowy illusions, to which he gave the names of ideas and impressions—ideas existing without a mind to conceive them; and impressions without an object to produce, or a subject to receive them.

Listen to the following confession of Fichte, cited by Sir Wm. Hamilton, in his notes on Reid. He says:—"The sum total is this. There is absolutely nothing permanent either without me or within me, but only an unceasing change. I know absolutely nothing of any existence, not even of my own. I myself know nothing, and am nothing. Images there are; they constitute all that apparently exists, and what they know of themselves is after the manner of images; images that pass and vanish without there being aught to witness their transition; that consist, in fact, of the images of images, without significance, and without an aim. I myself am one of these images; nay, I am not even thus much, but only a confused image of images. All reality is converted into a marvellous dream, without a life to dream of, and without a mind to dream; into a dream made up only of a dream of itself. Perception is a dream. Thought, the source of all the existence, and all the reality which I imagine to myself of my existence, of my power, of my destination, is the dream of that dream."

Can we wonder that the instinctive belief of mankind revolted from these monstrous conclusions, and that the philosophy which led to them should have been repudiated, even by many who were unable to detect the fallacies that lurked beneath? Reid tells us that he himself first embraced the ideal system of Berkeley; but, startled at the frightful conclusions logically deduced from it by Hume, he was driven to examine the foundations upon which so amazing a superstructure was raised, and finding that it consisted of a mere hypothesis—destitute of proof and opposed to the universal convictions of mankind

—he determined, as he calls it, to appeal from philosophy to common sense; or, to speak more accurately, from the philosophy of conjecture to the philosophy of consciousness. This appeal to the intuitive beliefs of mankind, which he calls common sense, is the fundamental portion of Reid's philosophy, and forms, indeed, the connecting-link between his system and that of Sir Wm. Hamilton. It is true that Reid does not appear himself to have comprehended the full value of the principle he enunciated; that his language on the doctrine of perception is sometimes confused, ambiguous, and inconsistent; that his degradation of consciousness to a special faculty of the mind, instead of regarding it as the universal condition of thought, is unsatisfactory in the extreme; still, with all these defects, he is entitled to our warmest admiration as being the first in this country who, equally removed from the sensuism of Locke and the scepticism of Hume, endeavoured, not unsuccessfully, to build up a system of philosophy on just and rational foundations. I do not, of course, mean to assert that Reid was the sole author of what has since been called the Philosophy of Common Sense; it is rather for his merit as a reformer, calling attention to known, but generally forgotten or neglected, truths, that he deserves our esteem.

Partly, no doubt, in consequence of the inconsistencies I have named, the real import of Reid's doctrine of perception has been misapprehended by his successors—Stewart and Brown—and it was reserved for the illustrious subject of this evening's paper, to expound, correct, amplify, and illustrate it, with such fidelity of observation, felicity of language, and profundity of learning, as to stamp upon the sterling metal of Reid's philosophy the ineffaceable image and superscription of his own genius. I have already alluded to the accuracy and precision of Sir W. Hamilton's language. I cannot dwell upon this characteristic further than to remark,

that in this respect alone, if in no other, his writings deserve the careful study of all who appreciate the luminous revelation of profound thought upon the most difficult and complicated subjects.

I shall now proceed to sketch as rapidly, yet as faithfully as I can, the main outlines of Sir Wm. Hamilton's system, leaving the details to be filled in on a subsequent occasion. These outlines are drawn from the essays originally published in the *Edinburgh Review*, and since re-published under the title of *Discussions on Philosophy*—the notes and dissertations appended to the collected volume of Reid's works, and the two volumes of Lectures on Metaphysics given to the world since the author's death, by Professor Mansel and Mr. Veitch.

The condition of philosophy is the possibility of knowledge; but knowledge is only possible in, and through, consciousness. We know, only as we are conscious of knowing; we feel, only as we are conscious of feeling; we will, only as we are conscious of willing. Consciousness is thus the universal condition of thought. It cannot be logically defined;—" as the one highest source of comprehensibility, it cannot be comprehended under anything else." But though not susceptible of logical definition, it may be philosophically analyzed, and the facts obtained by this analysis form the only substantial foundation of a legitimate psychology. There are certain conditions or limitations of consciousness on which all philosophers are agreed. These are: 1st, that consciousness is an actual, not a potential, knowledge; 2nd, that it is an immediate, not a mediate, knowledge; 3rd, that it supposes a contrast—a discrimination; 4th and 5th, that it involves judgment and memory. Consciousness being thus the generic condition of all knowledge, the possibility of philosophy involves the veracity of consciousness; " for as philosophy is only a scientific development of the facts which consciousness reveals, it follows that philosophy, in denying or doubting the testi-

mony of consciousness, would deny or doubt its own existence." The value of this testimony is so admirably described in the following passage from Sir Wm. Hamilton's fifteenth lecture, that I quote it entire. He says:—"But if the testimony of consciousness be in itself confessedly above all suspicion, it follows that we inquire into the conditions or laws which regulate the legitimacy of its applications. The conscious mind being at once the source from which we must derive our knowledge of its phenomena, and the means through which that knowledge is obtained, psychology is only an evolution, by consciousness, of the facts which consciousness itself reveals. As every system of mental philosophy is thus only an exposition of these facts, every such system, consequently, is true and complete, as it fairly and fully exhibits what, and what only, consciousness exhibits. But, it may be objected, if consciousness be the only revelation we possess of our intellectual nature, and if consciousness be also the sole criterion by which we can interpret the meaning of what this revelation contains, this revelation must be very obscure, this criterion must be very uncertain, seeing that the various systems of philosophy all equally appeal to this revelation, and to this criterion, in support of the most contradictory opinions. As to the fact of the variety and contradiction of philosophical systems, this cannot be denied, and it is also true that all these systems either openly profess allegiance to consciousness, or silently confess its authority. But, admitting all this, I am still bold enough to maintain that consciousness affords not merely the only revelation and only criterion of philosophy, but that this revelation is naturally clear,—this criterion, in itself, unerring. The history of philosophy, like the history of theology, is only, it is too true, the history of variations, and we must admit of the book of consciousness what a great Calvinist divine bitterly confessed of the book of Scripture:

> 'Hic liber est in quo quærit sua dogmata quisque;
> Invenit et pariter dogmata quisque sua.'

In regard, however, to either revelation, it can be shown that the source of this diversity is not in the book, but in the reader. If men will go to the Bible, not to ask of it what they shall believe, but to find in it what they believe already, the standard of unity and truth becomes in human hands only a Lesbian rule. And if philosophers, in place of evolving their doctrines out of consciousness, resort to consciousness only when they are able to quote its authority in confirmation of their preconceived opinions, philosophical systems, like the sandals of Theramenes, may fit any feet, but can never pretend to represent the immutability of nature. And that philosophers have been, for the most part, guilty of this, it is not extremely difficult to show. They have seldom, or never, taken the facts of consciousness, the whole facts of consciousness, and nothing but the facts of consciousness. They have either overlooked, or rejected, or interpolated."

In founding a system of philosophy upon the data of consciousness, Sir Wm. Hamilton lays down three fundamental laws, or conditions of legitimacy, which he denominates —1st. The law of parcimony. 2nd. The law of integrity. 3rd. The law of harmony.

I. By the law of parcimony we are to understand that no fact is to be assumed as a fact of consciousness unless it be ultimate and simple. "Whenever," says Sir William Hamilton, "in our analysis of the intellectual phenomena, we arrive at an element which we cannot reduce to a generalization from experience, but which lies at the root of all experience, and which we cannot, therefore, resolve into any higher principle—this we properly call a fact of consciousness. Being thus a primary, it must also be a necessary condition of thought. It must be impossible not to think it. As ultimate, it must be accompanied with simple belief in its reality. We know that it is; we cannot know how or why it is. These facts are of two kinds:—1st. The facts given in the act of

consciousness itself. 2nd. The facts which consciousness does not at once give, but to the reality of which it only bears evidence. Of the former, no doubt is, or can be, entertained; it is only of the latter that doubt is possible. It is not the reality, but the veracity of consciousness which is to be proved. II. By the law of integrity is meant that the whole of the facts of consciousness be taken into account. III. By the law of harmony, that nothing but the facts of consciousness, or inferences legitimately deduced from them, in due relation and subordination, be admitted; and that every position contradictory of them be rejected."

Such are the simple conditions which Sir Wm. Hamilton has prescribed for the investigation of the facts of consciousness. They are so obvious and self-evident that it might seem unnecessary formally to enunciate them, did not the history of philosophy show their constant and systematic violation. Hence, the various conflicting theories on the subject of perception, and the contradictory schemes of idealism, materialism, pantheism, scepticism, which have been based upon them. All these theories implicitly deny the veracity of consciousness, as manifested in the act of perception. In an act of perception I am immediately conscious, first of myself, the Ego, or subject knowing; second, of something different from myself—a non-Ego, or object known. Both are given in the same act of perception; they are known together, and known in contrast to each other. "When," says Sir Wm. Hamilton, "I concentrate my attention in the simplest act of perception, I return from my observation with the most irresistible conviction of two facts, or rather two branches of the same fact—that I am, and that something different from me exists. In this act, I am conscious of myself as the perceiving subject, and of an external reality as the object perceived; and I am conscious of both existences in the same indivisible moment of intuition. The knowledge of the subject

does not precede nor follow the knowledge of the object—neither determines, neither is determined by, the other. The two terms stand in mutual counterpoise and equal independence." "Such is the fact of perception revealed in consciousness, and as such it determines mankind in general in their almost equal assurance of the reality of an external world, as of the existence of their own minds. Consciousness declares our knowledge of material qualities to be intuitive and immediate." This fact, as a phenomenon, is admitted even by those who deny the truth of its teaching. But though admitted as a phenomenon, the veracity of its testimony to aught beyond itself may be denied. It may be asserted that this phenomenon is merely illusive, that the non-Ego, or object, is merely a modification of the perceiving subject, or a *tertium quid* distinct from both, or that it is simply a representation of an unknown object in, and by, the subject. Or the testimony of consciousness to the ultimate duality of subject and object may be denied, or to their mutual equipoise and co-originality. According as one or other of these views is taken, idealism, materialism, absolute identity or pantheism, logically results. If the immediacy of our knowledge of the external world be denied, but the reality of its existence asserted, we have the doctrine which Hamilton designates cosmothetic idealism, or hypothetical dualism; the doctrine which, although of all others the most illogical and inconsistent, is that which has been received by the great majority of modern philosophers. These doctrines, though mutually repugnant, have yet one feature in common. They are all founded upon the denial, more or less complete, of the veracity of consciousness as manifested in external perception. But if consciousness be found a lying witness in this instance, why is its testimony to be believed in any? The original presumption in favour of its veracity is reversed—***Falsus in uno, falsus in omnibus***; and the line of Tennyson is philosophically true:

"Unfaith in aught, is want of faith in all."

Can we discriminate between the deliverances of consciousness so as to pronounce that one is true and another false? This involves the assertion of a faculty higher than consciousness, which thus becomes the judge of its contents. But what is to guarantee the veracity of this higher power, which is only a consciousness once removed from that which is the object of our doubt? However far back we may carry our analysis, it is evident that we must come at last to those primary and ultimate facts which, as such, cannot be resolved into any higher principle, and as the basis of all our reasonings must necessarily be believed as true. These we have called the facts of consciousness. If, then, the testimony of these facts be disputed or denied, knowledge is a shadow and philosophy a dream. Thus Leibnitz says:—"If immediate internal experience, or consciousness, were able to deceive us, it would not be possible to have for me any truth of fact, I add, nor of reason." But if by philosophizing we assert the possibility of philosophy, we are not entitled to assume the mendacity of consciousness. The testimony of consciousness, like that of any witness, is to be believed unless it can be shown to be false. But as the sole possible witness, consciousness can only be condemned out of its own mouth. This would be the case if the facts of consciousness were mutually contradictory, either directly in themselves, or indirectly in the consequences to which they necessarily lead. If this can be shown, the authority of consciousness is subverted, and with it the possibility of knowledge. "But," I quote from Sir Wm. Hamilton, "it will argue nothing against the trustworthiness of consciousness that all, or any of its deliverances, are inexplicable, are incomprehensible; that is, that we are unable to conceive through a higher notion *how* that is possible, which the deliverance avouches actually *to be*. To make the comprehensibility of a datum of consciousness the criterion of its truth would be, indeed, the climax of absurdity. For

the primary data of consciousness as themselves the conditions under which all else is comprehended, are necessarily themselves incomprehensible. We know, and can know only, that they are, not how they can be. To ask how an immediate fact of consciousness is possible, is to ask how consciousness is possible; and to ask how consciousness is possible, is to suppose that we have another consciousness before and above that human consciousness whose mode of operation we inquire. Could we answer this 'verily we should be as gods.'" But such repugnancy and self-contradiction of consciousness has not been, and cannot be proved; therefore, the evidence of consciousness is to be believed, and its testimony to the reality of our knowledge of the external world, of the mind or the subject knowing, of matter or the object known, of their co-existence, correlation, and equipoise, is to be accepted as true.

Such is a condensed account, given as nearly as possible in his own language, of Sir Wm. Hamilton's doctrine of the Evidence and Authority of Consciousness in Perception. It is to his system of philosophy what the Newtonian law of gravitation is to the science of astronomy, or the law of the equality of the angles of incidence and reflection to that of optics. It is the corner-stone of his Psychology, and on this solid and immovable basis he has reared an edifice, against which the rains may descend, and the floods come, and the winds of adverse prejudices may blow, without shaking or disturbing it, "for it is founded on a rock."

I shall conclude with briefly noticing Sir William Hamilton's doctrine of the Limitations of Human Knowledge, or, as it has been termed, "The Philosophy of the Conditioned." Is the domain of human knowledge co-extensive with the universe of existence? Is pure being, as it exists in itself and out of relation, an object of knowledge for us? Are our faculties competent to the immediate knowledge of the infinite and absolute; that is, of the unconditionally unlimited

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and the unconditionally limited? These are the questions that meet us on the threshold of philosophy. This intuition of the absolute and infinite has been the dream of philosophers from the dawn of speculation unto the present day. It underlies the whole scheme of mystical theology, and its possibility is regarded by Fichte and Schelling as requisite to afford a valid basis for a real philosophy. To reach it, system has been reared on system,

> " High as the tower which builders, vain,
> Presumptuous, piled on Shinar's plain;"

and the result has been alike, a "confusion of tongues." To these questions Sir Wm. Hamilton returns a direct negative. All knowledge exists in and by consciousness, but consciousness is only possible under the conditions of difference, plurality, and relation; and is, therefore, only of the conditioned, the relative, the phenomenal, the finite. The absolute—that which exists absolutely in itself and out of relation—and the infinite—cannot be objects of positive thought; they can only be conceived by abstracting the conditions under which thought is realized; they are negations of the conceivable. But, though inconceivable, they are not, therefore, to be regarded as non-existent. All positive thought is of the conditioned, and is "the mean between two contradictory extremes, both of which are inconceivable, but of which, as contradictories, one or other must, by the fundamental laws of thought, be admitted as necessary." "The mind is not represented as conceiving two propositions subversive of each other as equally possible; but only as unable to understand, as possible, either of two extremes; one of which, however, on the ground of their mutual repugnance, it is compelled to recognize as true."

"We are thus taught the salutary lesson that the capacity of thought is not to be constituted into the measure of existence; and are warned from recognizing the domain of our knowledge

as necessarily co-extensive with the horizon of our faith. And by a wonderful revelation we are thus, in the very consciousness of our inability to conceive aught above the relative and finite, inspired with a belief in the existence of something unconditioned beyond the sphere of all comprehensible reality."

The end, therefore, of this philosophy is the knowledge of our own ignorance. The conflicting claims of faith and reason are reconciled, and the boundaries of each determined. Reason is shown to be limited, but not fallacious. Faith is seen to be the complement of reason. Either without the other is inadequate to the whole of man's being. Those who assert the sufficiency of reason, whose speculations have never carried them as far as that "wall of adamant" which closes in all human knowledge, and of which, to use the metaphor of Sir James Mackintosh, "few suspect the existence until they are dashed against it," may echo the watchword of Abelard,—*Intellige ut credas*; but those who have fathomed the depths of consciousness, and explored the boundaries of human knowledge, will be inclined to accept the advice of the Prophet,—*Crede ut intelligas*, as the dictate alike of a higher faith and a profounder philosophy.

The CHAIRMAN having invited discussion;—

Mr. BIRCH bore testimony to the general accuracy with which the principles of Sir William Hamilton had been expressed in the paper. He drew especial attention to the threefold division, by Sir William Hamilton, of the Philosophy of Mind, into Phenomenology, Nomology, and Ontology, and expressed his deep regret that whilst the two former had been fully treated in the Lectures on Metaphysics and Logic, we did not possess any similar exposition of the latter.

The Rev. Mr. MACNAUGHT could not admit what appeared to be the practical result of this philosophy. We had no right to require belief in that which was incapable of logical proof; but the proof of a given fact did not necessarily involve a knowledge of its mode of existence. That which could not be logically defined was unintelligible, and, therefore, unworthy of belief. Referring to Bishop Berkeley's system, he thought it had been somewhat misunderstood. He did not think Berkeley meant to deny the existence of matter, but simply the existence of *substance*, as distinct from, and independent of, the *qualities* of matter.

Dr. Ihne complained that Sir William Hamilton had not solved the great problem of philosophy, *i.e.*, the knowledge of the absolute and the infinite. All philosophers, from Plato downwards, had split upon the rock of the absolute, and Sir William Hamilton had avoided the danger instead of overcoming it.

Mr. Clark then replied,—All knowledge departed from certain primary principles, which must be assumed to be true, though as being the basis of our reasoning they were incapable of logical proof, *i.e.*, of being deduced from higher principles than themselves. It was erroneous to suppose that nothing was to be believed which was not susceptible of being logically defined and proved. The facts of consciousness could not be so established, yet it was impossible to doubt their existence. Take the example of time. Either time had a commencement, or it had not. But it was impossible to conceive, *i.e.*, to construe positively in thought an absolute commencement of time; in other words, a period so remote that we could conceive nothing beyond it. On the other hand, it was equally impossible to conceive an absolutely unlimited, or infinite time, for that, amongst other difficulties, would require an infinite amount of time for its accomplishment. Both these notions are equally inconceivable—both are equally beyond the grasp of the logical understanding; but one or other must necessarily be believed as true. Precisely the same reasoning may be applied to the doctrine of space; and it might be shewn that whilst the notion of space as absolutely limited, on the one hand, or as infinite on the other, was inconceivable; one or other must, necessarily be believed as true. It would be easy to multiply indefinitely illustrations of the same principle; and so far from its being true that all belief rested upon logical demonstration, a careful analysis would shew that all demonstration rested upon assumptions necessarily believed, but unsusceptible of proof. The objection of Dr. Ihne might apply to those philosophers who, like Fichte, Schelling, and Cousin, asserted the immediate knowledge of the absolute and infinite to be the end of philosophy; but did not apply to Sir Wm. Hamilton, who declared at the outset that, by man, with his present faculties, such knowledge was unattainable. The services of Sir William Hamilton to philosophy were not, as had been asserted, purely negative; on the contrary, by showing the impossibility of arriving at truth in the direction hitherto sought, he has concentrated attention upon those paths in which she might certainly be found.

On the motion of the President, the thanks of the Society were unanimously voted to Mr. Clark for the paper he had read.

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